LAB NEWS
SPECIAL ISSUE
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State of the Labs

Unique Capabilities, Unique Opportunities

Ed. Note: President George Dacey recently shared with members of Public Affairs and Employee Communications Department 3160 his current views of Sandia's past, present, and future. This LAB NEWS [SLN] summary of that discussion represents Mr. Dacey's third "State of the Labs" message since he was named president in August 1981.

SLN: A general question first. How do you feel that 1984 went?

GCD: I think 84 was an extremely successful year. Our performance in the weapon program was very satisfactory. And in terms of recruiting, in terms of the reaction of our customers, so to speak, we have had a most successful year. We should be proud of what happened in 1984.

SLN: How is the weapon program going?

GCD: The performance of the weapon complex over the last several years since the major resurgence of weapon manufacture has in my view been outstanding. We went from a period of low production to the highest manufacturing rate in more than a decade without missing a single IOC [initial operations capability] milestone and without any major flap that interfered with either the production or the delivery of weapons. That is a major accomplishment — one which we ourselves doubted we could do and about which there were broad doubts expressed. So in a general sense, the performance of the weapons complex has been marvelous.

Now during that time, of course, we did encounter some development glitches; that's in the nature of development. We often talk about the problems; we often do *not* talk about the successes. We want to do, we can do, better. But I think that we should see the problems in the perspective of an overall program that is really very noteworthy. [See "Concerns in Weapons City — and Solutions"]

SLN: What's the rationale underlying the increased production?

GCD: It has been not to enlarge the number in, or the yield of, the stockpile. In fact, total yield is going down, and we are not increasing numbers of weapons in the stockpile in a significant way at all. The builds are primarily to substitute safer weapons that have more control features.

SLN: Which weapons are in Phase 3 now?

GCD: One is the W88 warhead for the Trident II D5 missile. It has solid support everywhere. It's one of our big programs, but it's going very smoothly. That's in spite of the fact that it constitutes an integrated design in which our solid state technology is being used more fully than in any other weapon.

SLN: What advantages does this technology hold for the weapon?

GCD: It has a very sophisticated compensating fuze — the radar senses inaccuracies in targeting and adjusts the fuzing to maximize target kill. This is one of the early, primitive uses of artificial intelligence in a weapon.

SLN: How about the MX?

GCD: The MX, that is, the Peacekeeper missile, which carries the Mk21 reentry vehicle, has political problems, but they don't affect the development program. We're in the middle of flight testing the MX, so as far as we're concerned it's a solid program. It passed some major milestones late last year.

SLN: Where are we with the Anti-Submarine Weapon?

GCD: ASW undoubtedly will be the largest program, in terms of a development effort, that we have done for a long time. We are doing the whole payload for this family of missiles for the tactical Navy. Again from the standpoint of a development program, it's solid. The flight test program is going along at a high rate. And it's a very challenging job in that it combines some of the features of a warhead and a bomb.

SLN: Is the ASW now in Phase 3?

GCD: Technically, it's still in Phase 2-A, but we're running at a Phase 3 level to keep up with the Navy flight test program.

SLN: What do you predict for the future of these three programs?

GCD: From a technical standpoint there is really no impediment to success on any of those three — the Trident, the ASW, or the MX. But the MX, as you know, is a real political "on again-off again" thing, and whether it will ever turn out to be produced in the numbers that were originally considered is something that no one knows.

SLN: How about the nuclear artillery shell?

GCD: The W82, the 6-inch shell, has been the most unstable program we've had in a long time — so unstable from the standpoint of production that it *has* affected our development program. We had planned to disband the project team, as

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President George Dacey

Concerns in Weapon City — and Solutions

SLN: We hear that there are "concerns in weapon city." That is, is the weapon program as effectively manned and as healthy as it could be? Do you believe those troubles are real or imaginary?

GCD: Some of each, though I'd use the term "perceptual," rather than imaginary. No problem is imaginary if you perceive that you're facing it.

SLN: How about an example on the real side?

GCD: There's the question as to whether we are applying enough manpower to the weapons programs. That concerns me too. We have more Phase 3 programs going now than we've ever had. And if you look at the amount of manpower per Phase 3 back in the 70s and compare it with the numbers we are able to apply in the 80s, you find there are 20 to 30 percent fewer people per Phase 3 (in terms of direct support) now than there were then.

SLN: What are we doing to compensate?

GCD: Since that time we have increased the education of our staff, and we have increased the computer aids and other kinds of modern technologies that support our engineering staff. So even with the greater sophistication of our weapons, we seem to be coping with the load with a decreased staff. Nevertheless, I am concerned as to whether we are taking greater risk in our development work than we would like.

SLN: An example of a perceptual problem?

GCD: When you come from a period when you have not had very many weapons produced for a while and then you suddenly go into full production again, as we did in 1983, you have people observing the process who weren't around when you were in full production before. They see the natural, normal problems of production and they're new to them because they came from a period when there were no problems because there was no production.

SLN: Are you speaking of our own people or people in, say, Washington?

GCD: A few in each location. They say, "Oh my God, we are having a lot of problems. We weren't having them a few years ago." Of course — we weren't *producing* anything then, so naturally we didn't have any problems! You can overemphasize the problem side of things if you don't have a perspective that leads you to understand that the development process is going to have problems. That's the nature of development.

SLN: How about the question of whether we're losing all our experience in weapon development through retirements? Is that a real or a perceptual problem?

GCD: Some of each. Dick Claassen headed a committee that looked at this and other possible problems. When they looked at the spectrum of development experience in the weapon program, they found that it was no different from the Labs as a whole. You had some young people, some middle-aged people, and some older people all working on a weapon project in about the same mix as you find on an energy project or any other project. So while I think there is some general perception that the experienced hands are leaving and they are going to hurt the weapon program — and while there is some truth to that — I think you can get a distorted picture if you think that all of our new people are working on wild new ideas and none of them are working on the bread-and-butter weapon program — that just isn't so.

The committee also looked into another concern: are we getting more deviations in new weapons out of the production agencies than we used to? The statistics don't bear that out. We seem to be developing weapons now very much with the same quality that we've always had.

SLN: But you did say there's some reality to the retiree problem.

GCD: It is certainly true that we have entered a period with many retirements of people who have been with the program for a long time. That does mean a loss of expertise with respect to manufacturing process and interaction with the production complex. It's also true, I think, that the new people we hire are somewhat different, both in terms of their educational experience and in terms of the mores of our times, from the people that we hired 25 years ago. The schools don't turn out people with quite the same interest in manufacture as in the past. They are generally more interested in theoretical things, in design matters, in exploratory kinds of engineering. Universities these days don't emphasize the final elements of the process — manufacture itself, factory concerns. So our people don't come in with quite the same built-in training toward the practical side of things as they did in the past.

SLN: But haven't we changed our responsibilities in relation to the production complex over the last couple of decades?

GCD: We have in fact moved some of the responsibilities that were historically Sandia's to the production complex. When Sandia was founded, it was planned that Sandia would itself manufacture the weapons; in fact, some of the first buildings that were built here were built as factories. But the realization quickly came that that wasn't the right way to do it and so the integrated contractor production complex was established.

Nevertheless, in the early years Sandia retained much of the responsibility for the manufacturing processes — for the loading of the factories in efficient ways, scheduling, etc. There has been a continuous process of Sandia moving toward the earlier phases — design, research and development, etc. The rest of the complex has picked up some of the later phases of the development process — the manufacturing engineering and the problems of process control and quality control — not quality assurance, quality control. So the historic view — cradle-to-the-grave responsibility for weapons, including all aspects of weapons, even including their manufacture — is no longer viable. We have in fact given manufacturing responsibility to the factories. I think that, were it not for that shift, we would clearly not be able to do what we're doing with the number of people we have now.

SLN: Have we clarified the implications of that shift in responsibility sufficiently?

GCD: Perhaps not. Some people may feel they still have full responsibility but have neither the authority nor the resources to carry out that responsibility. So they feel very frustrated when a problem occurs because they know they can't do anything about it — it's up to the factory to have to do something.

This is a good time to restate our function here: total cradle-to-the-grave responsibility for weapons *with respect to their design and their quality and the assurance that the design intent is met by the factory*. But those things that are specifically related to the manufacture itself are the factories' responsibility — with, of course, Sandia's cooperative help whenever needed or required. But there is a difference between helping someone else with his responsibility and feeling responsible for it yourself. I think it's that distinction that we are now trying to draw. It's not something we are changing — it's a recognition that has in fact occurred over many years.

So in response to the complaint of "we don't have the resources to do everything like we used to do," the answer is "well, yes, but we aren't *trying* to do everything that we used to."

SLN: Do you think that that clarification will ease the problem of our relationship with the production complex?

GCD: Not by itself. We are discussing with the factories a way to engage them in a kind of training program for our new designers. We would like our new design people to spend a few weeks in the factories, being exposed to the environment in which their designs will ultimately be manufactured. This training period might involve taking introductory courses of various kinds taught by the factory people and including their concerns; seeing the machines that they will be designing for; talking to the factory people about the kinds of problems that they face when a drawing with certain tolerances, for example, comes down the pike. So before our people get deeply involved in a design for a part to be manufactured they know more about how it will be produced and therefore will be able to design more smoothly for that activity. That's perhaps the biggest change planned.

SLN: Any plans to have people from the factories come here?

GCD: We would like to get the factory people involved earlier in the design process. So design reviews involving the factory people are also a part of this whole thing. Generally, what we want to do is to introduce those programs that will help us get our people more familiar with the factories and the factory people more familiar with us at the necessary points of interface — which *have* changed over the years. We want to close any gaps in the development process as it moves from design into manufacturing.

SLN: Anything else in our relationship with the production complex?

GCD: At the end of the design of a weapon every process is now categorized as either A, B, or C. A processes are those that we and the factory agree they know how to do so they're turned over to them, and C's are ones that are new technology where we take full responsibility for development of process and responsibility for getting the factory up to speed and doing it. B processes are in between. Of course the goal is to get all the pro-

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cesses transferred to A's, and we've made a lot of progress on that. There is now a formal definition of A, B, and C, and the system is being implemented in a formal way in all the production agencies.

SLN: You said earlier that we do have a problem of loss of expertise as experienced people retire. What are we doing there?

GCD: We are using artificial intelligence to try to capture some of the expertise of the old-timers before they leave. So to the extent that one can produce an expert computer system that will preserve that corporate memory, that expertise, that will help to ease the transition. For example, we now have a system for designing cables that has captured some of the know-how that the cable designers of the past have developed over the years. We certainly want to go further in that direction wherever it is appropriate.

SLN: What other changes are in the works?

GCD: One is that we intend to reemphasize the University Part Time program. If we can hire people at a bachelor's degree level and then participate in the selection of their advanced training courses and have that advanced training take place in the job setting, then the orientation of such a person toward the more practical and manufacturing side of the business is more likely to evolve in the direction that we desire.

SLN: In general, are you satisfied with the direction in which we're going?

GCD: Let's put the issue in some perspective: In 1983 we did go into production on three very complex weapon systems in one year. We hadn't done that for a long time, so there were a lot of problems. But in 84 most of those problems were solved, and the complex is running along very well. I think we've recovered from the learning curve that accompanies getting back into business.

SLN: Any predictions about what weapon production is going to look like over the long haul?

GCD: No one can foresee what the long-range production program is going to be. If you go far enough into the future, the crystal ball becomes very hazy. I personally hope that the nation recognizes that, to remain strong and to have a continuing deterent capability, it's necessary to have a continuously modernized stockpile and that it's very dangerous to allow yourself to be satisfied over long periods of time with technology that gets older in real time.

It's inconceivable to me that 50 years from now we would be trying to deter nuclear war with 50-year-old weapons with no one then alive who was involved in the development of those weapons. And yet some proponents of arms control, especially those people involved with comprehensive test ban views, appear to be satisfied with the feeling that you can do that. If what seems to me common sense reigns and our future weapons utilize whatever the technologies of those times are and are modernized to provide all the features then feasible that are not now feasible, then there will have to be a continuing program of development and manufacture. That will involve the same kinds of interactions with the factory that we have now. But that's a big "if."

directed, and phase out of development as of the end of FY84. Now it appears it might be back in — Congress has put $50 million in the budget for production of the 82.

SLN: How about our two bomb programs?

GCD: The B83 strategic bomb is in successful production — we've finished development, but there's some cleanup to do. We're currently making major improvements in the safety and control of the new mods for the B61, that is, the B61 6, 7, and 8s.

The most important challenge for us is to design smarter weapons, add more intelligence to weapons, and to develop short-range weapons with more capabilities.

SLN: What kinds of weapons programs do you see for Sandia in the immediate future?

GCD: The most important challenge for us is to design smarter weapons, add more intelligence to weapons, and to develop short-range weapons with more capabilities.

SLN: SWERVE [Sandia Winged Energetic Reentry Vehicle Experiment] is a high-technology, maneuverable, aerodynamic vehicle. Isn't it an example of that kind of weapon?

GCD: Yes, and so is the strategic penetrator. They represent capabilities for the country that we don't now have. But the technology is here. One of our major jobs is to get some of these new weapons into Phase 3 development.

SLN: What can we say about SWERVE?

GCD: The technology now exists to put enough intelligence in a weapon to identify characteristics of certain targets and home in on them. It's clear also that there is a tradeoff between yield and accuracy: for given targets, the more accurate you are, the less yield you need. All of that is in the direction of reducing the collateral damage to surrounding territory when a military target is attacked by nuclear weapons.

SLN: Wouldn't penetrator weapons also lead to that direction?

GCD: Yes, that takes it another step: penetrators bury the nuclear detonation so that most of the energy is contained in the ground. That means you can have lower yield, but it can be more effective in killing hard targets with lower collateral damage. That means, in turn, that you don't get fallout and firestorms so there's less chance of a nuclear winter.

SLN: So why isn't the country building these now?

GCD: It's tough technology. The challenge for both SWERVE and strategic penetrators is to combine high velocities and pretty high accuracy with high intelligence to allow terminal maneuvering. The immediate challenge is to demonstrate that developing these capabilities is actually do-able and then to get the attention of the people who need them. I think such weapons are important new additions to the capabilities of the country. The day of gravity-dropped bombs is about gone, I think.

SLN: Does this concern with new concepts signal any change in our traditional responsibilities in weapon development?

GCD: Our traditional responsibilities have not lessened. We are as responsible for nuclear ordnance engineering as we have ever been. There is no expectation that that will diminish over the years.

On the other hand, it is clear, I think, that technology has created the possibility of conventional weapons — that is, weapons that contain other than nuclear explosives — that were not feasible in previous generations. Although there is as yet no other alternative to nuclear explosions for missions that involve very large expenditures of energy to produce a very large effect, the trends in conventional weapons permit new kinds of approaches to traditional problems.

Our problem is to determine that degree to which the technologies that we have acquired in our nuclear weapon mission should be applied to and coupled with — on behalf of the national interest — some of these newer opportunities.

SLN: How does our involvement with the SDI [Strategic Defense Initiative] program fit here?

Our part of SDI is to contribute once again those unique points of view and technical capabilities that we've acquired over the years as a result of our major mission.

GCD: The SDI effort is one example of that; it happens to be defensive rather than offensive, but it seems to me that our part of SDI is to contribute once again those unique points of view and technical capabilities that we've acquired over the years as a result of our major mission.

There isn't any question in my mind that in some areas of technology we do in fact lead the country. In command-and-control and safety and vulnerability and countermeasures, for example, we have had more experience than any other laboratory. And I think we have more to contribute in terms of a multidisciplinary spectrum of engineering skills and technologies — again we probably have a broader spectrum than most laboratories, certainly the government laboratories; we range all the way from materials and research and in-house semiconductor capabilities through to system design and integration.

So I think there isn't any doubt that we have technological resources that could be very useful as the nation moves into major new thrusts. Those thrusts seem to me to have two major characteristics: one is the application of high technology to conventional weapons, and the other is a reemphasis on defensive systems as part of the total spectrum of war-deterring and war-fighting capability.

SLN: Reemphasis?

GCD: Yes. In the 60s an antiballistic missile defense was a legitimate program for a nation to engage in. After the ABM [anti-ballistic missile] treaty and as a part of the debate that took place about the effectiveness of the Sentinel and Safeguard systems, defense technology got a bad name for quite a long time. We as a nation were putting most of our eggs in the offense basket, and it was almost a taboo to talk about defensive systems.

To my mind, the major importance of

the President's speech and now the emphasis on SDI, wrongly called "Star Wars," is not that we see our way to a clear, absolute defensive system. Rather it's that any nation's security has to depend on the full range of technologies available to it. So if we learn more about those technologies that are important for defensive systems, we will have a national security posture that is more balanced, more useful, and more likely to lead to a diminution of offensive systems.

Any nation's security has to depend on the full range of technologies available to it.

SLN: How involved is Sandia in SDI?

GCD: Our effort in SDI is relatively small compared to the nation as a whole — $30 million out of $1400 million this fiscal year and a projected $40 million out of $3500 million in 1986. On the other hand, I think our piece of SDI is important and unique in that we are probably better qualified than most to consider the countermeasures and vulnerability side of Star Wars. We have some unique capabilities in the pulsed power area and other areas that we are applying to the SDI problem.

It's also true, of course, that the Russians are trying to make SDI an important element in the upcoming arms control negotiations because it threatens their efforts to get ahead of us. So the program as a whole is subject to potential evolution, and we don't know quite where it is going to go. Our part of it, however, is reasonably clear and small enough that we can envision a certain amount of stability: we're not likely to get big "on again/off again" projects in our part of SDI. We traditionally try to manage our work in such a way that no single technical limb, if it gets sawed off, is a disaster for Sandia. We try to hedge our bets as we make them. That's easy for SDI because much of the work we do is work we'd be doing anyway for effects simulation or inertial confinement fusion.

SLN: The President's budget included an appropriation for our new SDI building in Area IV. What's the function of that building?

GCD: There is general recognition that many of the problems we will have to solve if the nation gets heavily into SDI are engineering problems, not only science problems. That's where we come in. SDI represents some of the most challenging technologies imaginable.

We traditionally try to manage our work in such a way that no single technical limb, if it gets sawed off, is a disaster for Sandia. We try to hedge our bets as we make them.

I've had some people tell me the challenges are too great, that there's no way to make them practical. I don't believe that. There are many things in the field of technology we can do today that couldn't be done 20 years ago when we were working on defense systems. But we can not only do them now; they're easy. Many of them center on major advances in electronics, particularly hardened electronics.

Even if the SDI program gets deemphasized over the next several years, I think it's unlikely that the nation will be so foolish as to deemphasize the engineering technologies we are talking about. So I think the fundamental programmatic purposes for which the SDI building is intended are something that the nation should and will continue to support.

SLN: How about the RHIC [radiation-hardened integrated circuit] lab? We seem to be facing some opposition to it. Why do we consider it so important?

GCD: Given what is conceivably possible in software, in artifical intelligence systems and expert systems, in learning systems, in computer systems of enormously greater complexity as the chip revolution wears on, I think it's clear that there will be great applications to our kinds of business. We haven't as yet forged a program or established a reputation here that is comparable to what we have done in, say, materials and combustion.

I think that the next really big scientific thrust that we need to emphasize more in the future is in this general area of artificial intelligence. After all, where we have recognized a broad field and have emphasized it by hiring the best people we can and managing it as well as we know how, we have a record of success of which we can be very proud.

So I think that the next really big scientific thrust that we need to emphasize more in the future is in this general area of artificial intelligence, chip revolution, super computers, strategic computing, smart weapons — whatever you want to call it. After all, where we have recognized a broad field and have emphasized it by hiring the best people we can and managing it as well as we know how, we have a record of success of which we can be very proud; that's true in materials, it's true in combustion, it's true in pulsed power, it's true in weapon effects.

SLN: And the next "generation" in Sandia technology might come out of the RHIC lab?

GCD: That's part of it. The next big one, I think, is that having to do with the power of modern chips and software technology in realizing artificial intelligence and smart weaponry and so on. The RHIC lab is an important ingredient here because these capabilities become greatly enhanced if one can go to the next generation of complexity. It's commonplace now to find more than a million active devices on a chip of silicon, but not when those devices have to have radiation-hard capabilities.

The next generation beyond that will go perhaps to 10 million or more devices on a chip; when that level of complexity is reached, qualitatively new kinds of systems become possible. The chip itself becomes not an element in a functionality but a complete set of functionalities within the same chip — you sort of leap to the next plateau of system integration in which, instead of dealing with circuits, you are dealing with functions and in which the complexity of tasks that one can do becomes another layer higher. That makes a whole set of things possible.

SLN: What kinds of capabilities are you thinking of?

GCD: Don Shuster used to quote the bumble bee story: If you look at the capability of the brain of the bumble bee, you find that its active elements are no more complex than what we can build into one of these super chips. Yet a bumble bee and its sensory system can distinguish between a flower and a thistle and do all sorts of tasks that involve a form of rudimentary intelligence. Yet our weapons, our radars, can't tell the difference between a truck and a tank, much less a Russian tank and an American tank. The bumble bee could, with a no more complex brain.

So the kinds of things that you could do if you have available to you really intelligent devices and sensors in the warfare of the future boggles the imagination. But you never get there if you don't have the ingredients to get there.

SLN: Will this artificial intelligence direction require more than just a gradual reallocation of our resources?

GCD: I don't think so. It will be gradual, because what happens in anything like this is that a few very talented, gifted, dedicated, obsessed maybe, people lead the revolution. Until you have a few key people who have a vision and a mission and a dream to set the direction and attract to their program the numbers of other people that are needed, you don't get anywhere. You have to know where you are going before you mount a major challenge, a major expedition. What we have now is an understanding of what the broad direction is: we know it's more or less north, but we don't know whether it's north by northeast two degrees or what. What we need is good explorers. Over the next year or so we are going to try to bring in as bright and as energized and as imaginative people as we can to get us underway.

SLN: Let's put this theme in context. You don't mean that you see Sandia leading the chip revolution singlehandedly, do you?

GCD: Of course not. When we talk about artifical intelligence and chip revolutions — this whole spectrum of capabilities for the future — we are really talking about a broad thrust of science and technology over the whole world, and in this country in particular; the industrial community, the scientific community, the academic community are all fervently involved. We do not expect or desire to beat the rest of the world. But we want to be assured that we are *coupled* to that revolution in thought as it occurs and that we have people here who are contributing to it, so they can steer those elements of it that are relevant to us into our activities.

And the same thing can be said for the RHIC lab: we are not trying to compete with industry. What we are trying to do is to take the industrial revolution in chips and adapt it — in particular the radiation-hardening aspects of it — to our unique needs, needs that we cannot depend upon industry to meet because they're relatively small on the industrial scale.

SLN: Over the years Sandia has achieved an enviable reputation in radiation hardening, a small but very important area of microelectronics. What other areas, in addition to nuclear ordnance, do you believe are especially noteworthy?

GCD: We have a number of accomplishments that we can be very proud

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Technical Accomplishments 1984 Special Section

LAB NEWS

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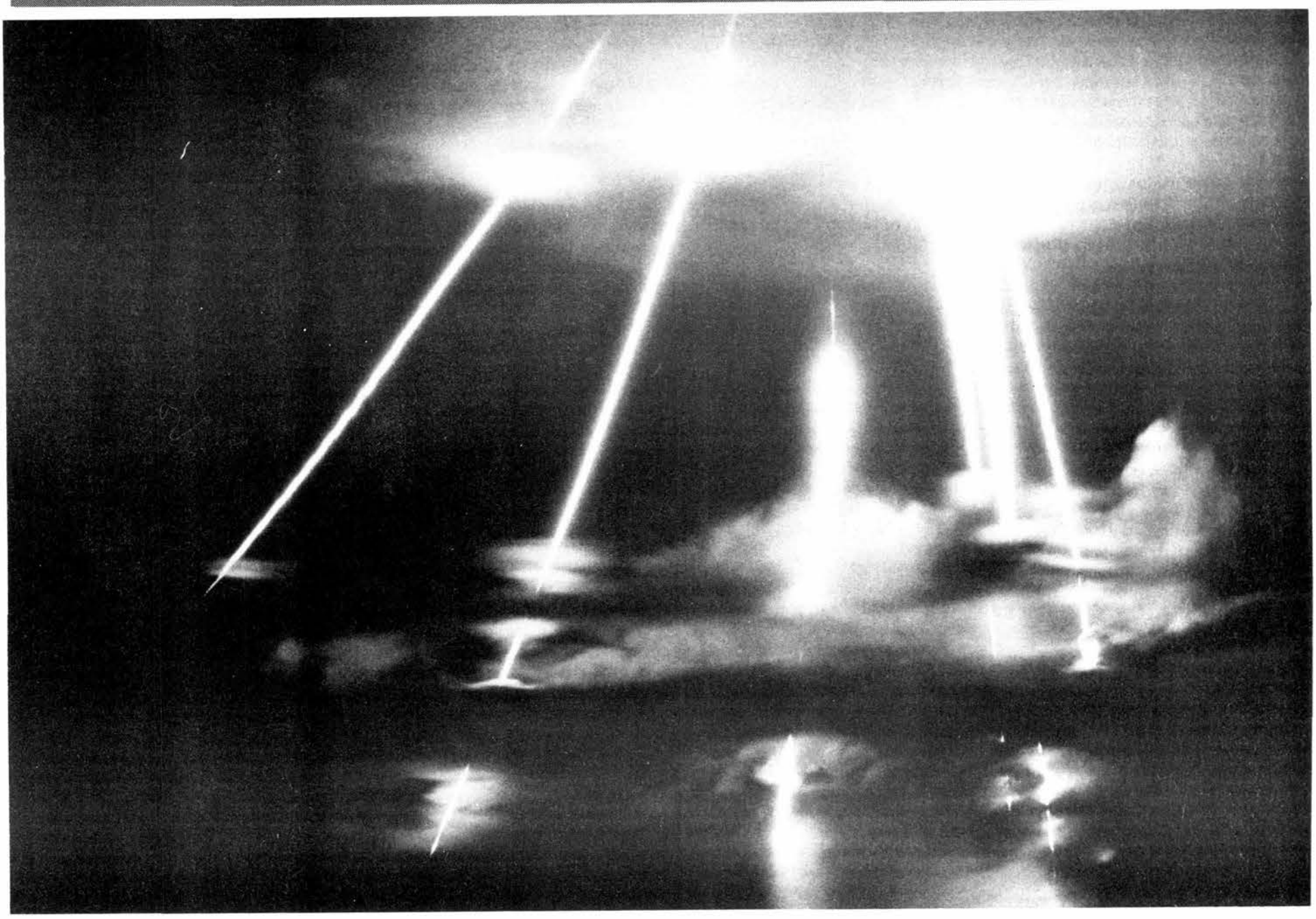


STREAKS of flaming ablation material mark the paths of MX/Peacekeeper reentry vehicles entering the Kwajalein terminal area after launch from Vandenberg Air Force Base, Calif. It was a successful development flight test of the missile system. (Weapon Systems - 8130)

Technical Accomplishments 1984

Continuing a LAB NEWS feature begun four years ago, *Technical Accomplishments 1984* sums up what we, Sandia National Laboratories, consider our principal technical achievements for the year just past.

The work summarized here has been submitted by technical organizations in Albuquerque, Livermore, and Tonopah. No attempt has been made to rank items. The responsible department is given in parentheses after each item.

Weapons Systems

• Collaborating with Y-12 and three commercial sources, we completed the development and initiated production of an inertia weld between large, thick hollow cylinders. This joint, stronger and almost as tough as the base metals, allows us to substitute low alloy steel (4330V) for a much more expensive alloy steel (HP 9-4-20). This mid-production change is expected to save more than $10 million and reduce our dependence on cobalt, an element in HP 9-4-20 that must be imported. The entire development costs, including special tooling for production, totaled about $1 million. The process has promise for a number of fabrication welds. (8310)

• The B83 and W84 entered into full production status during the year. Several significant system tests used hardware produced for the stockpile. B83 and W84 flight tests verified system function. In addition, seven B83 development units were flown on the B1 bomber to confirm design compatibility between bomb and aircraft. For the W84 program, special tests confirmed the compatibility of explosive environments with critical electrical functions. (8160)

• The Mk21/W87 Reentry Vehicle (RV) was successfully tested in the sixth MX/Peacekeeper Missile development flight. The mission was flown from Vandenberg Air Force Base, Calif., to Kwajalein Missile Range-North, a distance of approximately 4130 nautical miles.

The DOE Mk21 Mod 2A RV mission represents the first flight test of a functional Sandia W87 Warhead Electrical System. All Mk21/W87 warhead test objectives were met. (8130)

• We have developed a new UV-cured epoxide protective coating that can be cured in seconds with photoinitiators to a clear, durable surface. This coating is 100 percent solids. Compared to other solvent-based coatings, it has the following advantages: low outgassing, low cure shrinkage, rapid processing, good aging, non-toxicity, and excellent electrical and mechanical properties. The coating will bond to virtually any clean substrate. The coating is to be used in several weapon programs. This technology has been transferred to BKC. (7470)

• The first underground test of W87 cabling for System-Generated Electromagnetic Pulse (SGEMP) effects was successfully accomplished in the Midas Myth underground nuclear ef-

fects test. Consistent data were obtained on the performance of electron suppression features, radiation-induced conductivity behavior, and terminal protection component capabilities. (8130)

• A high-frequency acoustic nosetip recession gage has been developed and successfully used on a number of reentry vehicle flights. The gage measures the changes in nosetip length caused by ablation. The compact electronic system sends out ultrasonic waves, digitizes the return echoes, and averages them. The data are then stretched in time and sent by telemetry to be recorded on the ground. After the reentry test, the data are processed to provide high accuracy nosetip length measurements. (7550)

• As part of a penetration technology program, we are developing configurations suitable for high-speed, unretarded water penetration. These penetrator configurations have been investigated through wind tunnel tests and scale-model water entry tests. These configurations investigate the effect of variations in external shape, center of gravity location, and structural materials on stability and loads. Tests have been successfully conducted with instrumented penetrators. (8150)

• New computer-based ultrasonic nondestructive evaluation (NDE) technology has been successfuly applied to the evaluation of solid state bonds. Solid state bonds (such as diffusion bonds, pinch welds, and inertia welds) join similar and dissimilar metals without the problems associated with fusion welding. Until recently, the NDE technology to evaluate these bonds has been inadequate. The new technology is based on the application of advanced signal processing techniques to develop pattern recognition algorithms that correlate ultrasonic waveforms with bond quality. (8440)

• First Phase 6 production quantities of the W80-0 warhead were available on schedule in March to support the initial operating capability of the Sea-Launched Cruise Missile (SLCM) in June. The SLCM has been deployed in two U.S. warships. (5110)

• We designed the AN/GWM-9 Aircraft Monitor and Control (AMAC) test set for the Air Force Strategic Air Command to provide flight line checkout of the B-52 and FB-111A AMAC systems as well as the special weapons release functions on the B-52. The AN/GWM-9 is a computer-controlled test set that measures the AMAC and release signals of the aircraft and then compares the measured signals to the required signals. Successful completion of the tests proves that the aircraft systems are operating within specifications and that the aircraft is ready for nuclear weapon(s). (5120)

• Tonopah Test Range's Telemetry Ground Station computers now perform laboratory-type evaluations of data from flight tests during JTA (joint test assembly) drops. Following the drop, recorded data are transferred to the main computer where an "on-the-spot" weapon report is generated. Since similar analyses are performed at Pantex in the Laboratory Test Program, the data from both the lab and flight programs can now be combined for various engineering and/or statistical evaluations. (7260)

• We achieved full production on the new Automated PAL Controller (APC) and its associated Portable Data Module to support the Ground-Launched Cruise Missile and the PAL-controlled weapons of the Air Force Strategic Air Command (SAC). These systems use encryption devices and advanced operator-interactive software packages to provide the DoD with a greatly simplified method for managing, handling, and verifying operational enabling codes. For example, automatic decryption capability eliminates the current, time-consuming manual system. Microcomputer-based operation of the APC also allows handling of much more data, giving the military additional planning flexibility. We are now developing an associated device for DOE headquarters use in planning code assignments and in encrypting data before transport to storage sites. (2330/5160)

• We have developed a computer simulation (called BVRD) that provides trajectory and position histories of boosters, reentry vehicles, and decoys associated with a strategic attack against US military targets. Projected technical capabilities of the attacking rocket forces are built into the code; these data include missile flight characteristics, reentry vehicle weights, warhead yields, and accuracies. The computer code allocates attacking missile resources to US targets in order to achieve the goals set by the operator (e.g., simultaneous missile launch with warheads arriving on targets in a predetermined sequence to achieve a desired kill probability).

The data can be manipulated to show how an attack progresses as viewed from various locations in space, such as a surveillance satellite or a defensive weapon platform. These studies help define the threat to be faced by a global strategic defensive system or any component of the strategic defense. (8470)

• We have used the SCABBARD combat simulation Cray-1S computer model to complete an evaluation of the effectiveness of selective nuclear weapon employments in interdicting second-echelon forces engaged in a major river crossing. The movements of more than 6500 combat vehicles were modeled in this simulation. Equipment losses, convoy rerouting, command and control disruption, and other effects were assessed in determining the delay imposed upon the enemy force. (8470)

• An instrumented, full-scale water entry test of the Nuclear Depth Bomb was conducted at the Navy's Pacific Missile Test Center. (5170)

• An instrumented, high-speed penetrator was fired by the Davis Gun into a massive basalt flow to demonstrate feasibility of surviving penetration into very hard rock. After penetrating one body length of basalt rubble, including a large basalt boulder, a second body length of penetration was obtained. Even though the instrumentation package sustained minor damage, the test showed that it is possible to design penetrators and instrumentation to survive hard rock penetration. (5340)

• We have developed a unique instrument for simulating fast, high-voltage noise (3000 volts in one-billionth of a second). Weapon electronic systems are required to operate in electrically noisy environments, making testing of both systems and components difficult. This new instrument is capable of testing noise susceptibility to assure that function will not be impaired during weapon operation. (8170)

• The DOE/AL Primary Standards Laboratory we operate has upgraded the Dual 6-Port Microwave Network Analyzer from a laboratory device "that works" into a mature, automated system that produces highly accurate scattering parameter and power calibrations on fixed or variable, one- or two-port devices for the weapons production complex. (7240)

• The Physical Electronics Lab (with the support of the Plating, Hybrid Microcircuits, and the Plastics Labs) has developed a unique process for bonding ferrite ceramic barriers into stainless steel header bodies for application in fire sets. The process makes use of a sputtered multi-layer metallic film on the ceramic material that allows ferrites to be joined to the metal header by vapor phase reflow soldering. The advantage of this process over conventional methods of metallizing and brazing is the elimination of process steps that chemically attack the ferrite materials. This technique has been transferred to Bendix Corporation, Kansas City (BKC) for use in fabricating prototype fire sets for electrical testing. (7470)

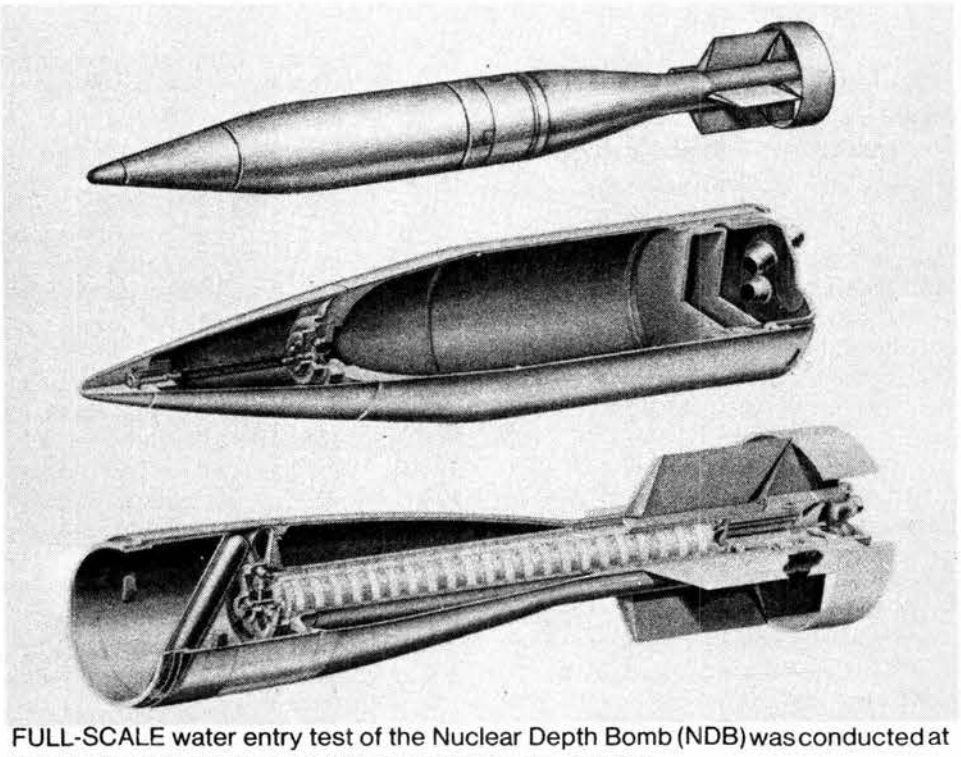
Components

• Many components use porous media (frits) to control gas flow. In the past, development of frits with specific properties has been severely hampered since most design parameters were based on limited, empirical information supplied by vendors. Our research (performed in collaboration with staff at the Michigan Technological University) has resulted in development of a model relating the flow behavior of frits to their microstructural characteristics. This model allows development of frits with specific properties tailored for Sandia applications and provides identification and control of processing steps important to ensure the quality of the porous media. (8310/8240)

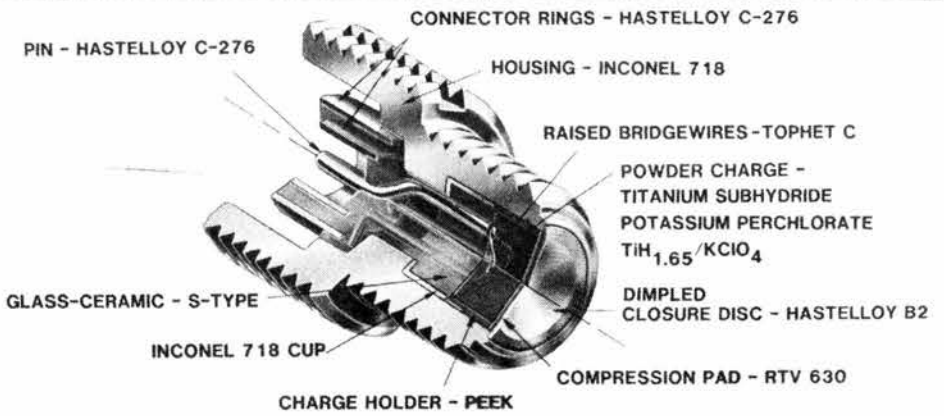
• In collaboration with Org. 1840, the Glass Lab developed a new class of corrosion-resistant glasses based on CABAL (calcium-boro-aluminate) system glasses. Finite corrosion rates of silicate-based glasses currently used in lithium ambient temperature battery headers limit the lifetime of the batteries to about five years. CABAL glasses offer several advantages over those silicate glasses: ease of forming; lower glass-to-metal sealing temperatures; stronger seal strengths; and, most importantly, much higher stability with respect to Li corrosion. Header lifetimes have been projected well beyond the five years of the present system. (7470)

• We performed extensive studies on the effects of various steps used in the manufacture of integrated circuits on the radiation tolerance of CMOS (Complementary Metal Oxide Semiconductor) devices. These studies led to improvements in the way circuits may be made in the CRM (Center for Radiation-Hardened Microelectronics). We have achieved an order of magnitude increase in total dose hardness over that of present technology, and we have demonstrated circuits that tolerate a total ionizing dose of 10^7 rads. In the future, CMOS integrated circuits on bulk silicon substrates with this radiation hardness will be available, presenting the potential for improved weapon and satellite systems. (2140)

• We have developed a new quartz digital accelerometer. With an innovative double-ended tuning fork geometry, an acceleration input is directly converted to a frequency output by the piezoelectric properties of quartz resonators and then digitized. The current design provides a continuous sampling of acceleration at millisecond intervals with a high degree of linearity over a −100 G to +100 G range. The sensing range can be changed by simple design adjustments. Features include small size, low power, inherent temperature compensation, and radiation hardness as well as relatively low cost. Design activities are currently underway for TSSG (trajectory-sensing sig-



FULL-SCALE water entry test of the Nuclear Depth Bomb (NDB) was conducted at the Pacific Missile Center. (Weapon Systems - 5170)



EXPLOSIVE ACTUATOR is one of a new family of pyrotechnic devices made possible by the development of high-strength, corrosion-resistant, thermally matched glass-to-metal seals. The seals can contain internal pressures greater than 100,000 psi. (Components - 2510/7470)

nal generator), guidance and fuzing, and other applications. (2530)

• We have added a new design capability to the Center for Radiation-Hardened Microelectronics (CRM) in the form of a radiation-hard CMOS Gate Array that has brought large reductions in both cost and production time. This array is capable of integrating 1500 2-input nand gates into one IC package. The G-1500 Array has 54 macro cells ranging in complexity from inverters to flip-flops and full adders. The device has 78 programmable I/O (input/output) pads. These pads can be bi-directional, TTL (transistor-transistor logic)-compatible, inverting or non-inverting inputs or outputs. A novel configuration called gate isolation allows higher density than conventional CMOS gate arrays.

This array is fully supported on the Daisy workstations from schematic capture and simulation to layout. This capability enables systems groups to control the design and schedule all the way through layout with no special training other than that provided with the Daisy workstation. (2110)

• We conducted an extensive weld development on Oxygen-Free-High Conductivity (OFHC) copper to determine the feasibility of obtaining high quality welds that satisfy stringent weapon requirements. The investigation included three machining techniques, two cleaning procedures, four joint designs, and multipass and hyperbaric welding techniques. Using the technology and equipment developed during this program, the Rockwell Rocky Flats plant was able to increase its acceptance rate on OFHC welds from 50 to 95 percent. (8180)

• Successful lithography in integrated circuit (IC) manufacture depends on the topographic structure of the microelectronic device. Steep hills and valleys lying below the layer being patterned produce poorly controlled feature sizes and a variety of other patterning problems. We have developed a low-temperature technique that can smooth the surface of an IC, permitting high resolution microlithography to be performed. By this technique it is possible to "sand down" the rough structure of an IC to form a smooth planar surface that is receptive to further patterning steps. This etch back planarization method is essential to the development and manufacture of radiation-hardened IC technologies with two levels of metal interconnections. (2140)

• In the past 18 months, we have designed nine integrated circuit (IC) types to support the Galileo space probe. The Sandia chips are drop-in equivalents of commercial chips used in the probe's attitude control computer and other systems. When the original parts proved too sensitive to cosmic radiation to be used on the mission to Jupiter, Jet Propulsion Lab (JPL) asked Sandia to develop a set of duplicate parts in hardened CMOS technology to minimize data loss. Due to the ever-decreasing size of transistors, data upset in digital ICs caused by high-energy particles is a serious problem for modern systems that operate outside the atmosphere.

Prototypes of the Sandia designs have been successfully tested for upset immunity and for correct performance in JPL's system. All nine of the designs were fully functional at the first fabrication try, an important plus since Galileo is scheduled for launch in May 1986. (2110)

• The Sandia-developed radiation-hardened 3-micrometer CMOS (Complementary Metal Oxide Semiconductor) LSIC (Large-Scale Integrated Circuit) technology reached production status. Components in this technology include the SA3000 microprocessor family and a large number of custom components. Systems supported include the Trident II, B61, W82, W87, and W81. This digital technology was extended to include a linear option. Production responsibility for the 3-micrometer technology has been assumed by the Bendix Albuquerque Operation. We have successfully transferred the technology to Harris Semiconductor Custom Integrated Circuit Division in Melbourne, Fla. Harris will be able to support production of the radiation-hardened SA3000 family in 1985. (2140)

• We have developed a new family of explosive actuators and ignitors that uses high-strength, corrosion-resistant alloys as well as Sandia-developed glass-ceramic sealed headers. This combination of materials produces very high strength, corrosion-resistant devices with strong, thermally matched glass ceramic-to-metal seals. These seals have demonstrated the capability of containing internal pressures greater than 100,000 psi. We used extensive computer analyses together with materials and process technology to develop very reliable pyrotechnic devices with the highest known strength-to-volume ratios. The most recently developed member of this family is an omni-directional connector.

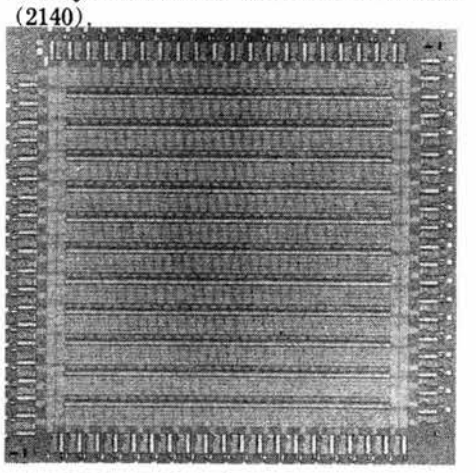
We have also developed fabrication processes that will enable one explosive actuator to withstand pressures of 150,000 psi. (The maximum strength of its predecessor is 60,000 psi.) The major factor in increasing the strength of this component was the reduction of water in the sealing glass: glass with low water content has no large hydrogen bubbles, formed by reaction with the metal during the sealing operation. The new actuator, currently in production at Mound Research Labs, uses Sandia-furnished low water content glass. The process technology has been transferred to Mound and to Schott Glass Technologies, Inc., in Duryea, Penn., where several large (40-liter) melts will be made to support production of the actuator. These developments have opened the way for a new generation of devices having greater strengths, safety, reliability, and producibility. (2510/7470)

• A new family of varistor ceramics has been developed for use as high-voltage regulators and electrical-surge-suppression components. Grain size, shape, and dopant distribution are critical to the performance of metal oxide varistors. We developed chemical precipitation techniques to create submicron particles of doping material and to coat the surface of each particle. To minimize grain growth during sintering of the ceramic, new powder consolidation and firing techniques were also developed. This research allows us to tailor the switching characteristics of a varistor while still maintaining a high non-linearity coefficient. (2530/1840)

• The first production lot of new environmental sensing devices for the B61-7 was delivered on schedule. The devices are larger versions of the rolamite switches that were invented at Sandia in the mid-sixties. The new components will survive mechanical shocks more than five times greater than the components they replace. Initial production yields are also greater, and production costs are anticipated to be approximately half that of the earlier devices. (2540)

• A system for containing the explosive in ferroelectric power supplies has been successfully demonstrated. It is lightweight and small but rugged enough to contain the detonation of a small explosive charge. The concept represents a breakthrough in the containment of explosive devices that would otherwise be destructive to adjacent components during flight tests. (2530)

• We have fabricated non-volatile memory cells for which the required programming voltage has been reduced to 10V. This compares to the 25V needed only two years ago. As a result, the 16K EEPROM (electrically erasable, programmable, read-only memory), now produced at Sandia, can be modified to operate with a single power supply, eliminating the special programming voltage commonly used in non-volatile memories. (2140)



LARGE REDUCTIONS in both cost and production time are the result of a new design for a radiation-hardened gate array. The new G-1500 Array integrates 1500 2-input nand gates into one IC package. A novel configuration called gate isolation allows higher density than conventional CMOS gate arrays. The array measures less than ¼-inch square. (Components - 2110)

Research Sciences

• The Glass Lab and the Inorganic Materials Chemistry Division have developed a process to thermally treat a bulk sol-gel prepared glass that provides an alternate method for the preparation of glasses that are difficult to melt conventionally. A major advantage of sol-gel-derived glasses is the energy savings from low processing temperatures (<700°C) compared to conventionally melted glasses (<1600°C). However gel-prepared glasses typically have a high water content that may limit their usefulness in sealing applications. Gel-prepared glasses that were heated under vacuum had a lower water content than comparable melted glass and exhibited the same mechanical properties. We have successfully prepared a leak-tight seal between quartz and pyrex using gel-prepared GSC-4 that was processed in this manner. (1840/7470)

• Theoretical and experimental research on the material properties of strained-layer superlattices (SLSs) demonstrated a number of novel features. Theory and observations show: strain-induced light holes (potentially allowing improved field effect transistors); tunable reflectance properties (allowing new types of discrete optical devices and integrated optics applications); the first demonstration of continuous wave operation of an SLS injection laser, and the first demonstration of ion implantation doping/electrical activation and lattice recovery of SLS structures and devices. (1130/1140/1150/1110)

• A new method has been discovered for efficient generation of tunable coherent radiation in the vacuum ultraviolet (VUV) region of the spectrum between 100 and 200 nm. Our VUV generation process involves the injection of high-power optical radiation into a metal-vapor sample to "optically induce" atomic resonances. These tunable resonances raise the efficiency for nonlinear optical sum-frequency generation processes used for VUV generation. This research may lead to widely tunable coherent sources in the VUV, which will find wide applications in high sensitivity time-resolved gas-phase measurement schemes used for trace detection, surface studies, and optical studies of chemical dynamics. (1120)

• We have completed the development of TACO3D, a state-of-the-art, three-dimensional, finite element, heat transfer program. The code is currently being used to analyze a wide range of thermal problems. Examples include a full-scale thermal model of reentry vehicle warheads and a variety of welding problems. The TACO3D analysis process has been linked to the computer-aided design (CAD) data base, thus allowing complex thermal models to be developed directly from the CAD design definitions. (8240)

• Generally, grain size influences the sensitivity of shock wave initiation of porous granular explosives; namely, the sensitivity increases with decreasing grain size. We have discovered and explained a reversal

FOUR DROP TESTS at Tonopah Test Range of a new parachute design — a cluster of three 25-ft. ribbon parachutes instead of a single 46.3 ft. parachute — demonstrated superior performance using the same payload. A new method for simultaneous disreef of the clustered parachutes (needed to distribute inflation loads evenly among the parachutes) was also successfully tested. (Research Sciences - 1630)

in this trend for the explosive hexanitrostilbene (HNS) when the grain size is below about 2 micrometers. A model of hot spot formation by pore collapse due to shock heating shows that hot spots associated with small pores (which are in turn associated with small grain size) exhibit reduced temperatures. When the pores are small compared to the width of the shock front, the temperatures are inadequate for the grain-burning process essential for explosive initiation. These results bear directly on the design of explosive components utilizing fine-grained HNS. (1130)

• Calculations of the unsteady aerodynamics of rapidly decelerating parachutes have suggested that a cluster of several small parachutes may have a performance advantage for low-altitude payload delivery over a single larger parachute with the same terminal drag area as the cluster. Four tests at Tonopah with a cluster of three 25-ft. ribbon parachutes demonstrated performance superior to that of a single 46.3-ft. parachute using the same payload. A new method for simultaneous disreef of the clustered parachutes (needed to distribute inflation loads evenly among the parachutes) has also been tested successfully. (1630)

• Phase transformation toughening combats the inherent brittleness of ceramics. We have invented a phase transformation-toughened glass-ceramic in which an ideal distribution of metastable tetragonal zirconia is precipitated directly from the melt. The material is toughened by a stress-nucleated zirconia phase transformation that impedes a growing crack. Unlike most toughening mechanisms, phase transformation toughening increases both strength and toughness of the material. (1840)

• We have developed a radiation pump source that will be used for x-ray laser experiments and x-ray coupling/material response studies. The water section and vacuum diode of the Proto-II accelerator in Area V have been redesigned to increase the energy coupled to an imploding Z-pinch load. In accord with theoretial predictions, these modifications more than double both the total radiation output (up to 100 kJ) and the x-ray laser pump radiation near 1 keV (up to 13.5 kJ). Our theoretical studies indicate that these radiation intensities are sufficient to begin interesting pulsed-power-driven x-ray laser experiments. (1270)

• A novel computer code has been developed to model bouyancy-driven fluid flows that can be used to predict the formation of plumes from large explosions, the effects of fires inside buildings, or the solution mining of salt caverns. The computational technique is very efficient: 10 to 100 times faster than conventional methods. The code output is interfaced to a computer graphics system to generate video movies for visualization of the results, and for direct comparison with experimental results. (1510)

• The first observation of an ordered superstructural array of hydrogen on a surface (111) of palladium has been made. The technique employed was Low Energy Electron Diffraction that revealed two distinct phases, denoted "primitive" and "centered" hexagonal. The primitive phase occurs at a hydrogen coverage of 1/3 monolayer and disorders at 85K; the centered hexagonal phase occurs at twice that coverage and remains ordered until 105K. Temperatures as low as 40K were used in determining the experimental phase diagram. The results are in excellent agreement with theoretical calculations based on the Embedded Atom Method, in which the energy of each atom is computed from the local electron density due to the surrounding lattice. The calculations also indicate a substantial population of subsurface sites. (8340)

• In most naturally occurring flows, the fluid is in such vigorous chaotic motion that it is said to be turbulent. In one of the first numerical calculations of its kind, we have been able to compute the time-dependent turbulent flow of air inside an enclosure arising from natural convection. The detailed momentum and thermodynamic fields were obtained without any empirical modeling. Agreement with experimentally known quantities for heat transfer and details of the structure of the viscous and thermal boundary layers is excellent. Our goal is the formulation of better turbulence correlations from these types of solutions, which can then be used reliably in much lesss expensive numerical models that do not account for the details of turbulence. (8240)

• Fragmentation from violent explosions or high velocity impacts is described by a new theory based on fundamental properties of materials. The theory applies to a broad range of materials including metals, brittle solids such as ceramics or rocks, and liquids. It has been incorporated into computer codes that can model the dynamic deformations following explosions or impacts. It has been used successfully in such diverse problems as the accidental non-nuclear detonation of weapons, the rubblization of oil shale to prepare *in-situ* retorts, and the explosive stimulation of oil and gas reservoirs. Other applications include conventional munitions, armor penetration, and assessment of lethality of proposed strategic defense weapons. (1530)

• Our research on the factoring of large integers has advanced the state of the art impressively -- factoring can now be accomplished several hundred times faster than just two years ago. Because the security of the RSA two-key crypto-algorithm, used in several Sandia programs and widely elsewhere as well, is based on the difficulty of factoring a large "public key," our research has had a direct impact on the determination of key size for cryptosecurity. Our results received considerable attention internationally in the public press, in part because of the implications for cryptography, but also because, as a byproduct of our research, we laid to rest the "Mersenne Conjecture" -- a famous problem that had been an open question for 300 years. (1640)

• Since the revolutionary discovery of two-key cryptography in 1976, a number of implementations have been proposed that are based on the difficulty of the so-called "knapsack problem." The knapsack cryptosystems were very attractive because they are much faster than other two-key systems that have been proposed; in addition, confidence in their security was high because they are based on a provably difficult mathematical problem. However, we discovered a cryptanalytic attack that, in a single stroke, showed that all of the knapsack-based cryptosystems proposed so far are, in fact, not cryptographically secure. For any of those systems, the cryptanalytic algorithm we developed will produce, in a reasonable amount of computing time, a decryption key that will work almost as well as the user's secret key. (Confidence in one of those knapsack-based systems was so high that a $1000 prize was offered -- and paid -- for Ernest Brickell's successful cryptanalysis.) (1640)

• A major modification program has improved flow quality and expanded the operating range of Sandia's 12'' Trisonic Wind Tunnel (TWT). New valves, stilling chamber, nozzles, test sections, and flow control choke have improved the uniformity of the flow, and a new model support system allows testing to higher angles of attack. While the transonic Mach number limit was originally 1.1, modifications to the choke and plenum exhaust system have now made testing in the critical Mach 1.1 to 1.3 regime possible. The supersonic Mach number limit has been increased to Mach 3.0, Reynolds number capability by 50 percent. These modifications enable the tunnel to provide experimental data consistent with the accuracy and reliability requirements associated with the design of today's weapon systems. (1630)

• A new class of radiation-hardened capacitor dielectrics has been developed by doping organic dielectric films with chemical impurities that act as traps for photocarriers. Our studies have shown that

Continued on Technical Accomplishments, Page Five

Safeguards

• On Aug. 30, the installation and integration of the perimeter alarm display and assessment system at Savannah River K Reactor, as well as the Entry Control System, were completed. These systems were turned over to du Pont for final preparation and operational readiness before dedicated security operation. Du Pont and Wackenhut worked to integrate their functions during September. The system went into dedicated operation on Sept. 28, meeting the milestone date for full operation. (5260)

• A modern Live Fire Range completed last year was transferred to the DOE and is a major part of the DOE's new Central Training Academy. (5210)

• We designed, developed, and installed a computer-based automated electronic surveillance system at the Idaho Chemical Processing Plant (ICPP). This Security Alarm Control System (SACS) uses electrical sensors and closed-circuit TV to assist a central security operator in maintaining the security of the facility. The SACS hardware is interfaced with a host computer to provide automatic CCTV assessment, alarm location, and security operational procedures on color monitors that incorporate touch control for operator interface actions. (5240)

• An integrated security system addressing both external and insider threats has been installed at N-Reactor, Hanford, Wash. State-of-the-art features incorporated in this integrated security system include: security-related displays for control room usage that are part of normal security personnel-oriented displays; pipe and valve monitors for operational and safety status of critical components of the plant; and specially designed enclosures for controlled access to areas containing critical complex components such as diesel generators and pneumatically operated valves. Access control is also part of the system design. (5240)

• We have developed an *in-situ* verifiable fiber optic seal system and delivered prototype hardware to the International Atomic Energy Agency for field test and evaluation. This system photographs the end of a multiple strand fiber optic cable of which several of the strands have been irreversibly and randomly severed to provide a unique identity for the seal. The disassembly of the seal or the substitution of the fiber optic link results in a different photographic record, furnishing evidence of tampering. The seals provide the IAEA with a more effective means of assuring that there has been no tampering with the containment of nuclear materials. (5250)

• A light fixture that emits only very-near infrared (VNIR) radiation has been developed for the Air Force for use in secure-area perimeters with TV camera surveillance. Security perimeters are commonly illuminated by standard streetlights at night in order to allow the use of closed circuit TV cameras. While this lighting allows high-quality TV imagery, the perimeter is also highly visible to adversaries and can annoy neighbors. The light from a VNIR fixture is invisible to people but not to the TV cameras. In this fixture, the visible light from the incandescent lamp is blocked by thin-film dichroic coatings and a glass filter. The resulting VNIR beam is uniformly spread by a special lens. The resulting IR illumination allows existing cameras to produce good quality TV images. Secure areas can now operate with inconspicuous, dark perimeters. (5230)

Good for the Kids, Good for the Labs

High School Students Aid Scientific Computing

SANDIA LIVERMORE NEWS
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During each of the past five years, a student from the Livermore Schools' Work Experience Education program has been employed part-time by Scientific Computing Division 8233. "They've proven their worth," says Bill Wilson (8320).

Bill made the original proposal for selecting students from the WEE program and has screened the applicants to pick one for each school year.

His first choice was Amanda Clements, then a senior at Livermore High, who worked from the fall of 1980 through the summer of 1981. She ran computer programs, made computer plots, and helped develop a program to make computer movies of lattice dynamics. "The job was a great experience," recalls Amanda. "I gained knowledge that I've been able to use in my summer jobs ever since." She's now a senior at the College of William and Mary (Williamsburg, Va.) where she's majoring in biology with an art minor. She plans to enter the Peace Corps after graduation, then go to graduate school for an advanced degree in biological science.

The second WEE student in 8233 was Donna Edwards from Granada High; her sister Julie is currently in the same job. Donna spent the 1981-82 school year and summer running production programs, making computer movies, and coding subroutines to analyze defect configurations in metal lattices. She plans to return to Sandia this summer and work with Steve Binkley (8233) in engineering. She's now a junior in electrical engineering at UC Davis.

Next was Jerry Friesen, a Livermore High senior who worked at Sandia in 1982-83. "I had taken a computer programming class in BASIC and elementary FORTRAN in school, but I learned much more about programming on the job at the Labs," says Jerry. He ran computer programs and helped implement routines to read tables of atomic wave functions and computer electron densities. "The training I got at Sandia has helped me get other part-time jobs since then," he reports. "And the Sandia experience sure looks good on my resume." Jerry worked last summer at LLNL in PASCAL programming and is currently employed part-time as a student attendant in the UC Davis computer center. He's in his sophomore year in electrical engineering.

The Computing Division's current student is Julie Edwards, who will graduate from Granada High in June and plans to major in economics at UC Davis. "I listened to my big sister and went after the Sandia position because I believe the future will revolve around computers," she notes. "I want to be able to use computers in many facets of my life. Besides, I needed some money for college." Julie had no prior experience in computers, but she has learned to run programs on the VAX system, has acquainted herself with FORTRAN, and is now enrolled in a PASCAL course at Granada. At Sandia, she has done fitting of data for models of metals and has performed many calculations of electron/photon transport in metals.

Chuck Bisson (8233) has worked with most of the students on site. "They have proven to be very competent and very productive," he says. "It doesn't take them long to get up to speed. And, by overlapping their time here, the departing student is able to help train the new one. All of them have been fantastic to work with."

"We've always made sure that these students are given the most challenging work they can handle — often, in fact, beyond that level," says Bill. "And they've always come through, enriching their own experience — and helping the Labs in the process."

BACK FOR A VISIT recently was the first work experience trainee, Amanda Clements, shown with current trainee Julie Edwards, Bill Wilson (8230), and Chuck Bisson (8233) at right.

FLOWERING CHERRY TREE was recently planted near the main entrance to Bldg. 911 as a memorial to Bill Zinke, supervisor of Experimental Solid Mechanics Division 8123, who died a year ago January. Wielding the shovel is Vice-President Dick Claassen (8000) with two of Bill's grandsons assisting. In back with Bill's widow, Eulailah Zinke, are two coworkers and close friends — Bill Alzheimer (8150) at left, and Bill Robinson (8240). Funds for the tree were donated by Mrs. Zinke's coworkers at Valley Memorial Hospital.

Antojitos

At the Moment -- You're reading the largest issue of the LAB NEWS ever published. We normally print a 12-page issue, sometimes a 16-pager. Some years ago, we went to a 20-page version once. This is a 24-page LAB NEWS. We don't pretend that bigger necessarily means better, but we hope that you'll find this issue is valuable to you, as a Sandian or non-Sandian interested in what the company has done in the past year and where it's going over the next couple of years.

Actually, it's all George Dacey's idea. He suggested last fall that if we could publish the annual Technical Accomplishments (usually published in January) at the same time that we ran his "State of the Labs" message (usually published in March) as well as Paul Stanford's "State of the Budget" message (published for the first time in December 1983), we'd have a kind of "Annual Report" that would summarize where we've been and where we're going. He felt that such a package would be useful in communicating the essence of Sandia to the more than 8000 employees and the 6000 or so non-employees (retirees, DOE and other government folks, AT&T people, etc.) who are on our mailing list. We're pleased to play a key role in that effort.

But we did not labor alone. We thank all of the people in the technical organizations who submitted summaries of their 1984 achievements, even if those achievements were not selected for publication here. We thank the technical line management up through the vice-presidents who had the difficult task of selecting the 20 or so top accomplishments from each vice-presidency for submission. We thank the people in Classification for reviewing a mass of material in a very short time. We thank the other LAB NEWS reviewers, especially Charlie Winter (400), for helping us shape the submissions into consistent, coherent form. We thank Paul Stanford and his people for help in preparing the "State of the Budget" article. We thank Executive V-P Tom Cook, who sat in on our interview with President Dacey and who contributed significantly to our discussion, especially as it concerned the weapon programs. And we thank Mr. Dacey, a most articulate and aware gentleman who recognizes the importance of open communications in building the vitality of the Labs. •BH

* * *

1. It is very difficult to forecast, especially about the future.
2. He who lives by the crystal ball soon learns to eat ground glass.
3. The moment you forecast, you know you're going to be wrong--you just don't know in which direction.
4. If you're ever right, never let them forget it.

--Economist Edgar Fiedler

LAB NEWS

Published Fortnightly on Fridays

SANDIA NATIONAL LABORATORIES

An Equal Opportunity Employer

ALBUQUERQUE, NEW MEXICO
LIVERMORE, CALIFORNIA
TONOPAH, NEVADA
AMARILLO, TEXAS

Sandia National Laboratories is operated by Sandia Corporation, a subsidiary of AT&T Technologies, Inc., and a prime contractor to the U.S. Department of Energy.

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LOUIS ERNE, Photographer
GERSE MARTINEZ, Assistant Photographer
BARRY SCHRADER, Livermore Reporter

Member, International Association of Business Communicators

Events Calendar

Feb. 15-17, 22-24, March 1-2 — Two One-Act Plays: "Big El's Best Friend" and "Private Wars," Fri. & Sat. 8 p.m., Sun. 6 p.m., Vortex Theatre, 247-8600.

Feb. 17 — "Bird of Freedom," Audubon Society wildlife film about the American bald eagle, 7:30 p.m., Popejoy.

Feb. 17 — Movietime at the KiMo: Movies by Great Directors, "She Wore a Yellow Ribbon," John Ford (1949), 7 p.m., KiMo.

Feb. 22 — Lecture: "Sensibility & Society in French 18th Century Drawings," Peter Walch; *March 1* — Lecture: "From Hero Worship to Nature Worship: The Major Revolution in 19th Century Art," Elwood Parry, III; Albuquerque Museum auditorium, 7:30 p.m.

Feb. 22 — KiMo Guitar Series: The Romeros, clasical and Spanish guitar, 8 p.m., KiMo.

Feb. 23 — NMSO Pops Concert, "Marching Along with Sousa," 8 p.m., Kiva Auditorium, Convention Center, 842-8565.

Feb. 24 — Preservation Hall Jazz Band, 4 p.m, First United Methodist Church, 4th & Lead, 243-5646.

Feb. 24 — Alma & Friends, Big Band Concert and album debut, 8 p.m., KiMo.

Feb. 25-26 — Liberace in Concert, 8 p.m., Kiva Auditorium, Convention Center, 766-5086.

Feb. 26 — KiMo Showtime: "Les Ballets Trockadero," 8 p.m., KiMo, 766-7816.

Feb. 27 — Travel film, "The Ozark Experience," 7:30 p.m., Popejoy.

Open House for Ray Powell

Vice President Ray Powell (3000) is retiring after more than 40 years at Sandia. An open house will be held for him on Feb. 26 from 2 to 4 p.m. at the Bldg. 861 cafeteria. Friends and acquaintances, including retirees, are invited to drop by.

Medical Corner

Workshop for Supervisors of Troubled Employees

It's not always easy for a supervisor to recognize employees whose personal and emotional problems are impairing their performance on the job. But if, for example, an employee is preoccupied with personal problems or is having difficulties in getting along with co-workers, his or her work is likely to suffer.

Even after the supervisor realizes that John or Mary has problems, it's hard to know what approach to take — or whether to intervene at all. But the natural urge to "close your eyes and hope the problems go away" is seldom the right decision.

What *is* the role of the supervisor in such situations? Medical is now offering a short training workshop for supervisors. It's called "Managing the Troubled Employee," and its purpose is to help managers and supervisors recognize and cope with employees whose problems are causing their job performance to suffer.

The workshop consists of one 2-hour session to be held on Thursday mornings from 10 to noon in Bldg. 802, Conference Room 229. Workshop leaders are Arlene Price, 3330 clinical psychologist, and Fred Johnson, 3321 supervisor. Workshops are set for March 7 and 21, April 11 and 18. Call Arlene for registration on 6-0021.

Fun & Games

Golf — Membership drive of the Sandia Women's Golf Association opens Tuesday, Feb. 19, with a cocktail party from 4:30 until 6:30 in the El Dorado Room of the Coronado Club. Membership is open to all Sandians, DOE employees, approved contractors, and their spouses and dependents. SWGA plans league play, tournaments, lessons, and instruction in the coming season. For more information, call Deborah Downs (5200) on 4-4474.

Construction to Start on New RHIC Laboratory

Construction starts later this year on Sandia's $40.5 million Radiation Hardened Integrated Circuit (RHIC) laboratory. The new 174,000-square-foot facility will be used by Bob Gregory's Microelectronics Organization 2100 to develop new radiation-hardened integrated circuits (ICs) with very large numbers of transistors per circuit.

Applications for these Ultra Large Scale Integrated (ULSI) circuits include advanced weapon systems and satellite programs. The organization expects that the complexity of ICs developed in the RHIC Facility will approach several million elements (such as transistors or diodes) on one chip, as well as 32-bit computer microprocessors on a single chip. Sandia does not have this capability at present.

According to Bob Gregory, Sandia's facilities in Bldg. 870 have enabled the Labs to become a leader in the development of hardened LSI components, but the facilities have reached their technological limits and have been turned over to Bendix for IC production. "The new RHIC laboratory will enable Sandia to apply its knowledge of radiation-hardening to develop the hardened ULSI circuits that will be central components in our systems of the '90s," Bob says. "Once developed, the technology and designs for radiation-hardened ICs are transferred to commercial IC vendors, such as Harris Semiconductor, for volume production."

An appropriations bill signed by President Reagan in July authorized $20 million for initial construction of the facility, which will be funded and built over a two-year period. Ground breaking for RHIC will be in mid-1985, and occupancy is expected in 1987.

The RHIC Facility will be located directly east of Bldg. 857 on the far southeast corner of Tech Area I. The two-story, multi-sectioned building will face M Street.

Of the total 174,000 square feet, 62,000 square feet is designated for offices and design, test, and assembly facilities; 46,000 square feet for fabrication related area; and 66,000 square feet for facility support areas.

More than 200 people will work in the facility on a multi-shift basis, seven days a week. Major emphasis will be on rapid development of new radiation-tolerant IC types, with the goal of a three-month turnaround time from design to assembled prototype circuit.

A key feature of the RHIC facility is its state-of-the-art, 12,000-square-foot wafer fabrication clean room using laminar air flow, the principle developed at Sandia in 1961 and now used worldwide to control airborne contamination.

"A massive engineering effort has resulted in the creation of a unique environment for wafer fabrication. It's unique in that all critical external influences, such as particulates, pollutants, temperature and humidity fluctuations, and ground vibration have been removed," says Mike DeWitte, supervisor of Building and Facilities Design Division II 3643 and head of the Labs' design team.

According to Mike, the RHIC clean room has been designed to allow only the minimum of particles in the work space that is currently technologically feasible — fewer than 10 particles of a 0.12-micron size or larger per cubic foot. (A human hair is 40 to 100 microns in diameter, and a bacterium is one to two microns in size.)

These clean conditions will be achieved by drawing more than 1.4 million cubic feet of air per minute through filters that are 99.99995 percent efficient in removing particles 0.12 micron or larger. The air drawn into the room will be conditioned to 70°F with 40 percent relative humidity.

The facility requires 31,000,000 Btu/hr of air conditioning, compared with a typical home requirement of 20,000 Btu/hr. Because of the critical nature of equipment used in the fabrication process, the clean room has also been engineered to have less than .2 microns of floor vibration.

Sandians who work in the clean room area will wear special uniforms to ensure that they do not degrade the ultra-clean environment. Without this uniform, one person in street clothing would add as much as 1,000,000 particles per minute to the clean room area. The clean room suit filters the air exhaled by the wearer before passing it back into the clean room environment. The uniforms, manufactured by Dryden Engineering of Santa Clara, Calif., will be cleaned in a special clean room laundry after each wearing.

"The clean room area is only a part of a very carefully engineered and coordinated facility," comments Doug Weaver, supervisor of RHIC Facility Design Management Division 2102 and RHIC technical manager. "The RHIC Facility is designed to bring together all of the critical aspects of the itnegrated circuit development activity in an environment that provides optimum conditions for meeting the development needs of new Sandia systems."

ENGINEERING MODEL of Sandia's new RHIC laboratory is examined by Doug Weaver (2102), RHIC technical manager. The model gives an idea of the way the two-story, multi-sectioned building will appear when construction is complete in 1987. The 320-foot-wide front section is an office/light laboratory area; the back section is divided into a fabrication clean room, support area, and an ultra-clean, state-of-the-art 12,000-square-foot clean room for wafer fabrication. A utility spine connects the two sections with a skylight area over the front. Architect firm for the $40.5 million project is Anderson, DeBartolo, Pan, Inc. of Tucson.

volunteers in action

News

Here are some current volunteer opportunities for employees, retirees, and family members. If you would like more information, call Karen Shane (3163) on 4-3268.

ALBUQUERQUE RAPE CRISIS CENTER needs volunteers in all its program areas: victim advocacy, phone advocacy, prevention and education, research and materials development, and office support. New training sessions begin this month.

TAYLOR MID SCHOOL, 8200 Guadalupe Trail NW, needs science fair judges on Monday, Feb. 25, from 9 a.m. to 3 p.m.

HUMAN SERVICES DEPARTMENT, STATE OF NEW MEXICO, is seeking adoptive parent(s) who can provide a loving, stable environment for "special needs" children. A "special needs" child meets at least one of the following criteria: over five years of age; a member of a sibling group; a member of a racial or ethnic minority; moderate to severe physical, psychological, or developmental handicap.

Supervisory Appointments

DALE RUTH to supervisor of Integrated Circuit Mask Layout Section 2113-1, effective Feb. 1.

Dale joined the Labs' drafting organization in 1963 as a mechanical designer. He's been project draftsman for the W72, W86, and other radar programs, and has been coordinator for the contract drafting organization. Dale was the mask designer for the LSI encryption chip. For the past six months, he's been with Exploratory Radar Development Division 2345.

He received his associate degree in mechanical engineering technology from Penn State. Dale is a Sandia recruiter for TI graduates at the 16 Penn State campuses and for numerous schools in New York City. He teaches electro-mechanical design at T-VI and engineering graphics at UNM. Dale coaches Little League football and is a member of the YAFL board of directors; he's also a licensed building contractor. Dale and his wife Sandra have three children. They live in the NE heights.

* * *

JOHN MATTER to supervisor of Intrusion Detection Systems Technology Division 5249, effective Jan. 16.

John joined Sandia's Space Systems Department in January 1976. He worked with this group on optical pulse propagation experiments to study the effects that clouds have on time distribution of pulse propagation. John has been with the division he now supervises since transferring to the Safeguards organization in March 1979.

DALE RUTH (2113-1), JOHN MATTER (5249), and RON HARTWIG (5155)

He received his BS in engineering from Swarthmore College (Penn.), his MS in EE from the University of Illinois, and his PhD in optical sciences from the University of Arizona. John enjoys tennis, swimming, cross-country skiing, and music. He and his wife Kathy have two children. They live in Sandia Park.

* * *

RON HARTWIG to supervisor of Fuzing Analysis Division 5155, effective Jan. 1.

Joining the Labs in June 1976 as a member of the technical staff, Ron was assigned to the Phase I and Phase II division in the weapons directorate. His work has been concerned with systems analysis, primarily in the advancement of fuzing concepts for strategic missile systems. Ron will continue with this work in his new division.

He received his BS, MS, and PhD in EE from Texas Tech in Lubbock. Ron enjoys photography and biking. He and his wife Janet have two children and live in the NE heights.

Welcome

Albuquerque
- Mary Cook (22-2)
- Arnold Elsbernd (2614)
- Terry Foty (2642)
- Mary Garcia (7222)
- Edward Holling, Jr. (2853)
- Polly Hopkins (1511)
- Walter Olson (1272)

Illinois
- Steven Heffelfinger (7535)
- Anthony Perlinski (2314)
- Russell Skocypec (6258)

New Mexico
- Phillip Cusenbary (1126)
- Philip Fajardo, II (2313)
- Anthony Gomez (7544)
- Gary Rogers (3713)
- Holly Welch (1126)

Pennsylvania
- George MacCosbe (7625)

Texas
- David Outka (1635)
- Jerry Rottler (1531)

Virginia
- Hugh Bandy (7126)

Wisconsin
- Michael Kelly (1821)

For Your Benefit

Tips for Filing Equitable Claims

Editor's Note: This new LAB NEWS column is designed to provide up-to-date information to Sandians and retirees about the services and programs of the Benefits Department and its Livermore counterpart.

Most of the delays and denials associated with health insurance claims grow out of failure to provide the information necessary for Equitable to process the claim. Here are some tips to help you minimize the hassle:

Claim Submissions

1. File the first claim when accumulated charges exceed the deductible, if any ($100 per individual or $300 per family of three or more members).
2. Complete items one through eight on the claim form. Claims received without the insured's correct Social Security number and signature will be delayed.
3. Submit one claim form for each individual family member receiving services. Accumulated expenses may be filed at one time rather than individually as each expense occurs.
4. Attach itemized statements. Intemized statements must include the following:
   a. The provider's name and phone number;
   b. The name of the patient;
   c. The nature of the illness or injury (diagnosis);
   d. The date of service;
   e. Description and/or procedure code of service rendered; and
   f. The charge for service.
   g. Prescription drug receipts must show the prescription number, the patient's name, the name of the prescribing physician, and the date and amount of the charge.
5. Claims submitted where Equitable is the secondary carrier must be accompanied by the primary carrier's Explanation of Benefits form.
6. Claims for Second Surgical Opinions must be submitted with a Second Surgical Opinion Benefits Claim Form. (The form and instructions are available from the Equitable Representative located in the Benefits Office in Albuquerque or from the Benefits Representative in Livermore.)
7. Claims must be submitted within two years fromthe date the service was performed.
8. Claims for on-roll Livermore employees should be submitted to Sandia National Laboratories, Benefits Division, Livermore, Calif. 94550. Claims for all other participants should be submitted to Sandia National Laboratories, Benefits Divsion, P.O. Box 5800, Albuquerque, NM 87185.

Telephone Inquiries

1. Any questions about claims should be directed to the Equitable Representative in Albuquerque at (505) 844-5858 or the Benefits Representative in Livermore at (415) 422-2252.
2. Please allow 30 days from the date you file the claim before inquiring about the status of that claim.

Written Inquiries

On all written correspondence to Equitable, indicate policy name (Sandia National Laboratories) and the insured's Social Security number.

Master Gardener Program

A Cure For Growing Pains

It's a cold February evening, but the two people don't notice the chill. They're thinking about summer as they look through the colorful pages of a seed catalog.

He: "Let's grow our own vegetables this year."

She: "Yes, a big garden in the backyard."

He: "I've been reading about 'raised beds' and 'drip irrigation'."

She: "I'd like to have some fruit trees, too."

He: "While we're at it, we could do some landscaping."

She: "No more gravel — a lush lawn with beds of pretty flowers."

Sounds like a good, simple plan, right? Could be if you've got the know-how, but gardening in Albuquerque isn't easy. Our couple will likely have questions in the beginning, and they'll continue to have questions once their gardening is underway.

* * *

One source for answering some of those questions is an Albuquerque Master Gardener.

One hundred gardeners are enrolled in the current Master Gardener program, sponsored by the Council of Albuquerque Garden Clubs and the Bernalillo County Extension Service. The 10-week course is held each Tuesday at the Albuquerque Garden Center. Master Gardener trainees (students who have three to five years of local gardening experience) receive 40 hours of classroom instruction. In return, each student volunteers a minimum of 40 hours during the year in various Master Gardener activities. Other students audit the classes with no volunteer commitment, or attend only those classes that they are interested in.

The Master Gardener program serves the public by providing educational information in a number of ways. The "Hot Line" telephone service is located at the Garden Center. Two Master Gardeners are available year 'round to answer gardening questions. The Hot Lines — 292-7144 and 292-7145 — are open from 9:30 a.m. to 2:30 p.m., Monday through Friday.

If a problem can't be diagnosed over the telephone, MGs often make house calls to help solve gardening problems. In addition, plant and gardening clinics are held at the Center and at shopping centers throughout the city. The public is encouraged to bring ailing plants, strange insects, or questions to these clinics where experts assist in identifying and suggesting ways to control the problems. The MG program also provides volunteers to staff an information booth at the State Fair.

Another activity is the 4-H Seeds program where MGs visit local elementary schools to instruct youngsters in vegetable gardening. Last year the MGs spent 350 volunteer hours visiting 1300 classes in 46 schools and reaching 3500 children.

MGs are working with horticulturists at NMSU to test new vegetable varieties for their suitability to this area. Specially trained MGs operate a soil testing laboratory at the Garden Center. And the annual Information Fair, held during August at the Center, continues to be one of the more popular events. The two-day program includes lectures, exhibits, and demonstrations on all aspects of gardening.

The Garden Center is located at 10120 Lomas NE. If you have a question for a MG, stop by the Center and talk to the Hot Line volunteers. While at the Center, tour the lovely patio and gardens, and visit the gift shop and library. The Center is operated by the Albuquerque Council of Garden Clubs and staffed by volunteers from local garden clubs.

THE LAB NEWS PHOTOGRAPHER visited the Albuquerque Garden Center and found these Sandia retirees — all Master Gardeners. Nick DeLollis was there for the day to answer questions on the Hot Line. Eunice Vleck (center) was visiting the Center for one of her many volunteer activities. And Dottie Bliss was there to audit the current Master Gardener training course. Other Sandia retirees who are MGs include Ed Johnson and Ken Gillespie.

Congratulations

Mark Anderson (1131) and Halley Patrick married Jan. 26 in Albuquerque.

Ron (2858) and Kathy Thorn, a daughter, Lindsay Katherine, Feb. 1.

Stephen (2321) and Rebecca Falacy, a daughter, Callie Marie, Jan. 18.

Mark (7172) and Deb Montavon, a daughter, Anne Marie, Feb. 4.

Sympathy

To Pat Walter (7545) on the death of his mother-in-law in Albuquerque, Feb. 2.

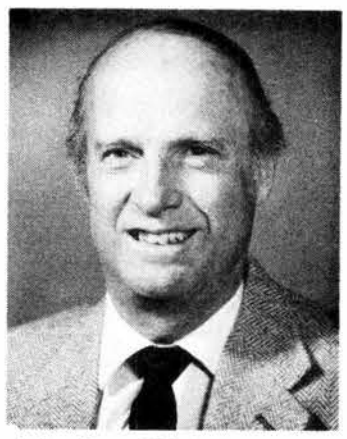
To Jim Doggett (7542) on the death of his father in Denver, Feb. 5.

USAF VICE CHIEF OF STAFF, Gen. Larry Welch (center), visited Sandia recently to discuss Sandia's weapons programs. His host was Everet Beckner, VP 6000 (right). Maj. Gen. Richard Phillips, commander of the AF Operational Test and Evaluation Center at KAFB, also attended the briefings, which included presentations by Beckner, Charlie Burks (5110), Marlyn Sterk (1651), and Bruce Miller (1270).

US REPRESENTATIVE Beverly Byron (Maryland), a member of the House Armed Services Committee, was hosted by Orval Jones, VP 5000, during her recent visit to the Labs. She was briefed by Bill Myre (5200), Roger Hagengruber (300), Max Newsom (5340), and Pace VanDevender (1200) on a variety of Sandia programs.

MILEPOSTS
LAB NEWS

FEBRUARY 1985

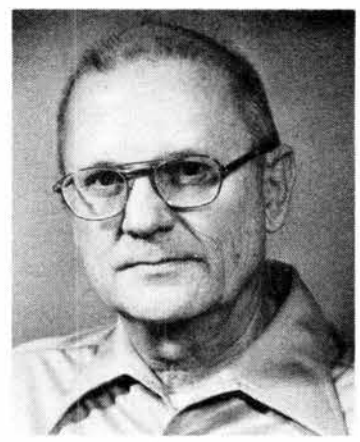


John Kane (5211) 25

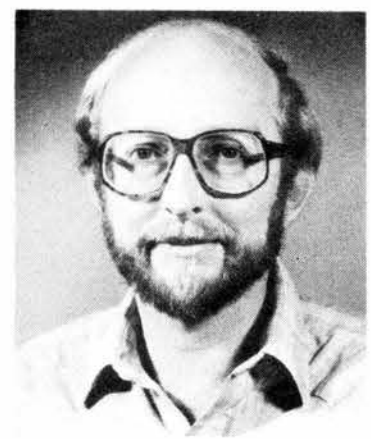
Ed Stout (7137) 35

Carol Kaemper (21) 15

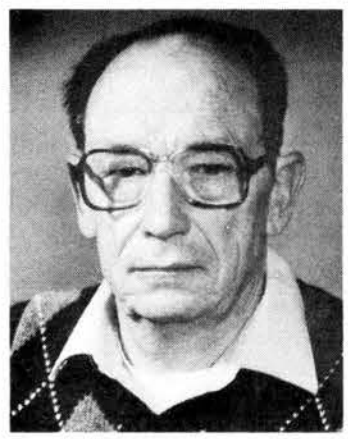
Don Tipton (5151) 25



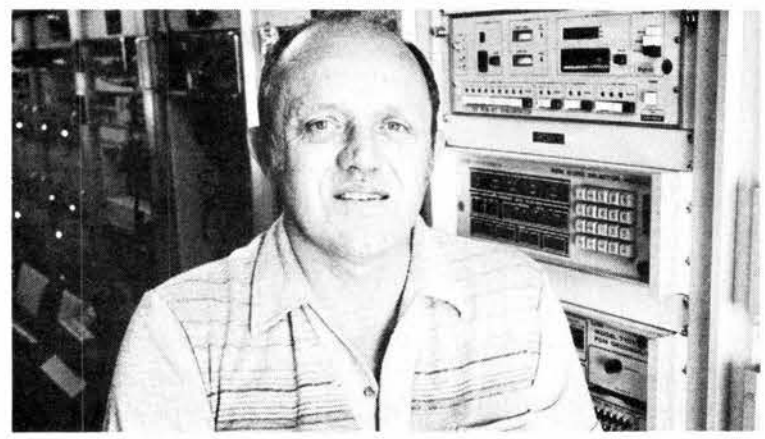
Nick Bourgeois (5238) 30



Jim Pierce (6323) 15



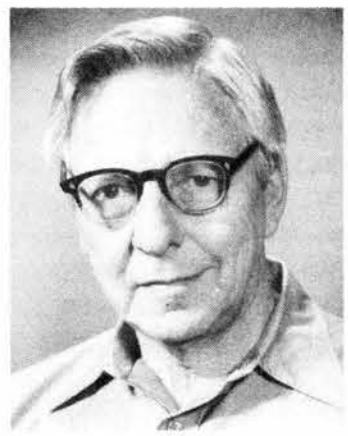
Simon Steely (5215) 25



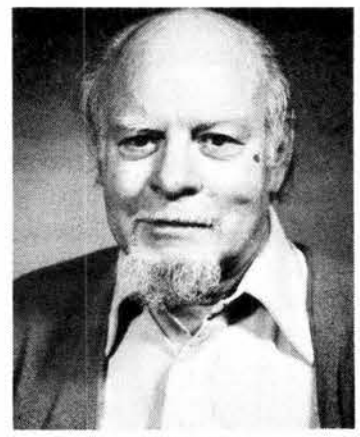
Bill Hoffman (7137) 25

Dick Isher (8274) 15

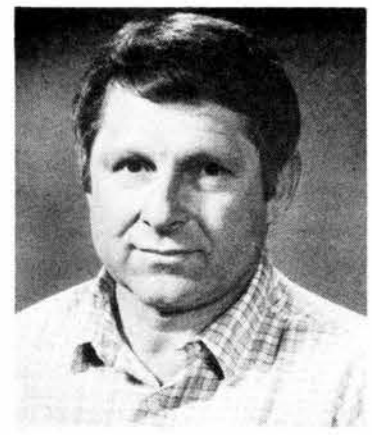
Bill Swansiger (8343) 15



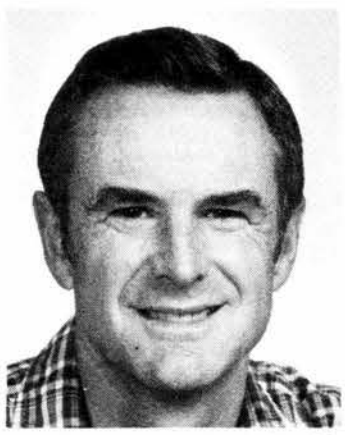
Dick Teisher (7133) 30



Joe Connell (7261) 35

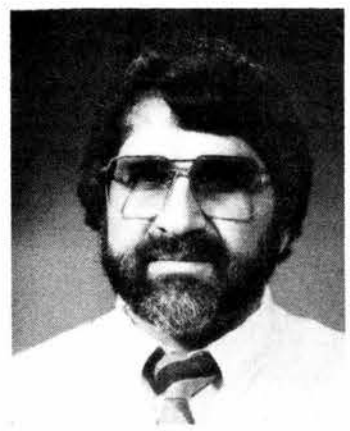


John Moyer (5211) 25

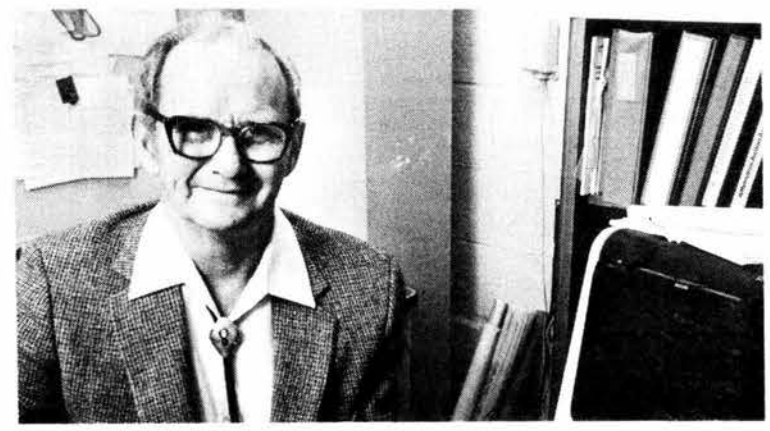


John Liebenberg (8132) 20

Willard Randall (3618) 30



Anthony Zuppero (5321) 15



John Snowdon (3632) 25

RETIRING

Al Smailer (3615)

Bill Hahn (155)

Warren Schaefer (2510)

Bud Elledge (7818)

Verne Honeyfield (3436)

Sylvia Sloan (7631)

Elmer Borbely (2626)

Ed Richardson (7265)

M.G. (Red) Young (7262)

UNCLASSIFIED ADVERTISEMENTS • UNCLASSIFIED ADVERTISEMENTS • UNCLASSIFIED ADVERTISEMENTS • UNCLASSIFIED ADVERTISEMENTS

Deadline: Friday noon before week of publication unless changed by holiday. Mail to: Div. 3162.

RULES

1. Limit 20 words.
2. One ad per issue per category.
3. Submit in writing. No phone-ins.
4. Use home telephone numbers.
5. For active and retired Sandians and DOE employees.
6. No commercial ads, please.
7. No more than two insertions of same ad.
8. Include name and organization.
9. Housing listed here for sale is available for occupancy without regard to race, creed, color, or national origin.

MISCELLANEOUS

IBM Selectric II, approx. 2 yrs. old, always under service contract, dual pitch, self-correcting, $895. Chavez, 881-2711.

COUCH, black naugahyde, $100; gold rayon couch, chair, ottoman, $300; floor lamp, $25; Phone-Mate, needs repair, $25. Falacy, 293-2517.

PIMENTEL rosewood guitar, $1000; cement mixer on wheels, $450; S&W 38 snub nose, model 15, $200; Unitek model 1-048-02 spot welder w/2-037-01 head, $400. Luther, 293-4462.

BUMPER pool table combination, dinner table, card table, make reasonable offer. Trujillo, 865-5438.

WOODEN secretarial desk, 30"x65" w/extension, 18"x40", $125. Sharp, 243-1498.

KARHU X-C skis, 195 cm, Fabiano model 398 boots, size 9M. Rodacy, 293-2668.

SOFA & matching love seat, beige Herculon, 1 yr. old, $450 for both. Zurwaski, 292-6694.

MATTRESS, waveless-type, for water bed, king size, 1 yr. old, make offer; truck tires, 12x15 highway type, used, radial, six ea., make offer. Arana, 299-1214.

SERTA king size firm mattress, box springs & frame, $200; Amana refrig., top freezer, avocado, $100. Kissam, 881-2895.

SEWING machine, Bernina Model 707 w/fitted portable, both for $350 OBO. Jercinovic, 844-7508.

FURNITURE: new desk, $50; complete bdr. set — dresser w/mirror, dbl. headboard, 2 night stands, $100. Gregory, 821-1429.

19" COLOR RCA TV, $150; Octagym rowing machine, $75. Eley, 296-3185.

ELECTRIC guitar amp, 30 watts, $100; Pearl distortion pedal, $30. Foor, 298-4980.

WATERBED, queen size, beatle pine bookcase, 6-dwr. pedestal, complete plus linens, $400. Levin, 345-9246.

BEDS: king size, 2 box springs, 1 mattress, Sears, $100; twin size, mattress, box springs, frame, Sears, $50. Dhooge, 897-4948.

CASSETTE deck, Dual C819, rebuilt 1 yr. ago by Audio Clinic, $165 OBO. Hammond, 296-9758.

'73 PILGRIM cabover camper, 9½ ft., self-contained, water heater, shower, oven, 2-way refrig., tripod jacks. Orth, 298-8838, 296-3450.

COUCH, burnt orange/beige, 90", Herculon fabric, $200. Blossom, 299-6709 after 5.

SHAG RUG, 9x12 brown, $15; bookcase headboard for full or queen bed, $20; wood & brass chandelier, $8. Kiefer, 296-2331.

MORGAN mare, 3 yrs. old; 6-yr.-old Quarterhorse gelding, both registered. Miller, 873-3450.

CRIB w/Simmons mattress, $50. Erwin, 836-2746.

15" SPOKE hub caps w/locks, still in packing, regularly $400, sell for $275 OBO. Rush, 293-7405 after 6

FREE, small juniper bushes, you dig. Eiffert, 268-1854.

DINING ROOM set, mahogany, table, 6 chairs, server, china closet, $150. Wimpling, 293-7926.

SANSUI rack system, AU317 amp., TU417 tuner, SR222MKII turntable, & Cannon TLS speakers, $1500 value for $650. Senglaub, 1-832-6369.

QUEEN size waterbed w/headboard, heater, padded side rails, $200; Realistic receiver & speakers, $150; Sanyo cassette deck, $75. Anderson, 292-5676.

OLYMPUS OM-10 35mm camera, electronic flash, 75-105 zoom lens, tripod & other extras, $275. Lewis, 296-7896.

UTILITY trailer, 2-wheel, 48W x 52L x 11H open box, $25. Janney, 881-4622.

RECORD sets: classical, lt. classical, operettas, inspirational, & western, played once or not at all, ½ price. Newton, 296-2335.

BABY crib without mattress. Rogers, 293-8201.

PIANO, Hamilton upright, blond wood, mirrors around top, $250 or make offer. Andrick, 298-6917.

TRANSPORTATION

'74 MAVERICK, AT, AC, 6-cyl., 250 cu. in., 4-dr., 78K miles, $1400. Knight, 299-3783.

'67 RIVIERA, all power, $995; 2 elec. cars: '63 Renault, $350; '71 Vega, $650, need batteries. Bassett, 898-1840.

'84 MAZDA RX7, red, low miles, sun roof, 5-yr./50K miles warranty transferable, tinted windows, louvers, bra, AM/FM cassette stereo, cover. Zarrella, 892-0822.

'73 PONTIAC Grand Prix, 65K miles, one owner, PW, cruise control, $2K. Dickason, 299-8125.

'82 KAWASAKI 750cc, 4-cyl., black & chrome, 1050 miles, $995 OBO. Ortega, 293-0510.

'78 DODGE half ton, $2K, V8, AT, 360 cu. in., tool box, 151K miles (highway). Dobbins, 892-7086.

'83 HONDA 1100, V65 motorcycle, $2900. Ulibarri, 883-2848.

'57 CHEVY 210 model, V8, AT, completely restored. Harris, 865-0140.

'83 PONTIAC TA, $10K OBO, low miles. Griffin, 298-9481 after 4:30.

'76 JEEP Wagoneer, $2500 OBO. Rayborn, 884-2509, Fountain, 293-2390.

'73 MERCURY Monterey 4-dr., V8, AT, PB, PS, AC, radio, CC, new tires, air shocks, $1800. Martin, 294-2381.

'76 TR7, new paint, tinted windows, sun roof, 30K miles on rebuilt engine. Brett, 266-4402.

'68 FORD Bronco, 4-spd., toploader trans., rollbar cage, soft top, headers, dual exhaust, new brakes, shocks, tires, stereo, $3200. Cordova, 881-2209.

'69 CAMARO 307, 3-spd., std., new tires, battery, hoses, carb., manifold, interior, more. $2150. McConnell, 831-0471.

'79 SAAB 900 EMS, blue, AC, sun roof, AM/FM cassette, new paint, one owner. Anderson, 299-1628.

'67 VALIANT, slant 6, PS, AT, $775 OBO. Shefelbine, 298-1674.

'74 OLDSMOBILE Cutlass Supreme, power, AC, 37K miles, maroon w/black interior, $1800. Blackledge, 294-6030.

'77 VW Rabbit, 75K miles, engine needs overhaul, $295. Barnes, 296-1758.

'83 CAMARO Z28, loaded, T-tops, extended warranty. Delnick, 298-5276.

'83 HONDA V-65 Magna, backrest, windshield, case-savers, highway pegs, low miles, $2800. Anderson, 292-5676.

'76 MUSTANG II, 4-cyl., PB, PS, AC, radio cassette, $800. Hey, 898-6679.

'76 PINTO 2-dr., AC, 3-spd., 4-cyl., $950. Gonzales, 821-7351.

BICYCLE, ladies single speed, w/light, generator, & basket, $35. Newton, 296-2335.

REAL ESTATE

MH, '72, 12'x60', located by river & nature center, 2-bdr., 1½ bath, $8K OBO. Vigil Lopez, 242-7001.

3-BDR., 1478 sq. ft., ½ acre lot, solars, fenced, landscaped, 4 yrs. old, Rio Rancho, 7¾ assumable (26 yrs. fixed), $73,500. Gurule, 294-6541.

MH, 2-bdr. + sun room, 1¾ bath, covered porch & carport, Wyoming Plaza. Chandler, 299-5389.

NE, 2-bdr., 1¾ bath, dbl. garage, 2½ yrs. old, $81,500, assumable loan. Vigil, 296-7021 after 5.

RIO RANCHO, 3-bdr., 1¾ bath, FP, carpets, drapes, dbl. gar., 6' fence, landscaped, 18x36 patio, wrought iron decor, $67K less 5%, $25K down, bal. at 10%. Hill, 298-7137.

FOUR HILLS Village, 4-bdr., den, w/fp, pantry, dbl. garage, lg. lot, mortgage $61,400 at 9½% assumable, $125K. Bailey, 298-0517.

3-BDR., 2-car garage, fenced ½ acre, SW area, low down, assumable loan, city water-sewer. Lundy, 877-9669.

RIO RANCHO, 4-bdr., 2 baths, 15x20 FR, lg. country kitchen, 1780 sq. ft., 2x6 construction, fully landscaped, 2-car garage. Menschel, 892-3363.

'83 MH, Golden West doublewide, in 4-Hills MHP (adult), energy pkg., many extras, assumable FHA. Finley, 294-3910 after 5.

TRIPLEX, 3 blocks to UNM, 1 bdr., FHA appraised. Butler, 242-5398.

WANTED

18' TRAVEL trailer, tandem axle, no AC, good condition. Falacy, 293-2517.

50MM f1.4 or f1.8 lens for Canon camera. Rodacy, 293-2668.

LAWN mower. Hill, 298-7137.

WILL pay $100 for one used Casio MT65 or MT-68 port. synthesizer in good condition. Roose, 296-4129 after 6.

GOOD home for poodle-terrier cross, 6 yrs. old. Lucero, 299-6300.

MEDICAL oxygen cylinder for my use, any size. Day, 881-2664.

SINGERS wanted, especially male voices for expanding SW Singers, to sing variety of good music. Robinson, 883-9717.

BARBELL-dumbell set for weight lifting. Snelling, 294-5751.

BABY crib. Martinez, 299-8438, 821-4571.

LATE model, low mileage ½ or ¾ ton Ford or Chevrolet pickup, 8' bed, 4-spd. Rogers, 293-8201.

UNM student wants older model economy car in good condition at reasonable price. Hueter, 299-7263.

PORTABLE electric typewriter. Kindschi, 256-0531.

Coronado Club Activities

Two-for-One Filet Mignon Set Tonight

TONIGHT, in honor of St. Valentine's Day, a sweetheart of a deal is offered in the Club's dining room -- filet mignon steak, two-for-one at $12.95. Singer/guitarist Robin Arquette entertains in the main lounge from 5 to 8 p.m. Paul Metoyer (3435) and Enchantment hold the bandstand in the ballroom for dancing from 8:30 to 12:30. Call the Club office, 265-6791, right now for reservations.

Next Friday, Feb. 22, is another two-for-one special (a change from the original announcement in the Club calendar). Two prime rib dinners are offered for $12.95. The Isleta Poor Boys return to the bandstand to play their popular brand of country and western music.

CORONADO SKI CLUB meets Tuesday, Feb. 19, at 7 p.m. in the ballroom for a program on Jackson Hole skiing. In addition, a movie on "hut hopping" from Aspen to Vail will be shown. The usual Ski Club prices will be available on refreshments and the usual fantastic door prizes will be given away.

THE RETIREE special interest group, now called the Thunderbirds, sends out the word that all Sandia and DOE retirees are invited to a dinner dance on Saturday, Feb. 23. Dinner is a super buffet spread topped by steamship round of roast beef. Booked for the occasion is the big 11-piece orchestra of Don Lesman. Lesman plays the old songs in the old big band style — you can recognize the melody and the words — and he's looking forward to playing the Coronado Club and a grand evening. The tab is $7. Call the Club office right away for reservations.

OTHER RETIREE ACTIVITIES include a card-playing session on Monday, March 4, starting at 10:30 a.m. in the El Dorado Room. Bring your own deck and plan on having lunch at the Club, then continuing the card party.

Also, if you are interested in forming a retirees single group, surviving spouses included, call the Club office, 265-6791, and leave your name.

A TRAVEL PROGRAM on Alaska and Alaskan cruises is set for Monday, Feb. 25, at 7:30 p.m. in the ballroom. Scheduled speakers are from Pajarito Travel.

The Club is sponsoring a one-day chartered bus trip to Chaco Canyon on Saturday, April 20, for $26. Chaco Canyon National Monument is the site of the most impressive ruins of ancient civilization in North America. A staff member from UNM's Chaco Center will accompany the tour. See travel director Marv Plugge (5171) at the travel table in the Club lobby tonight between 6 and 7 for more details. The travel committee also has information on the best commercial travel packages currently available.

Take Note

The American Intercultural Student Exchange (AISE) needs volunteer families to host high school students for the 1985-86 school year. Students, ages 15 through 18, from Sweden, Norway, Denmark, Finland, Holland, Germany, France, Spain, Italy, Colombia, Brazil, Australia, Malaysia, Singapore, Korea, Hong Kong, and Japan will arrive in the U.S. in August. They will attend a local high school and return to their home country in late June 1986. All are fluent in English, have been screened by school representatives in their home countries, and have spending money and medical insurance.

AISE representatives are also interviewing interested local high school students for exchange students from the U.S. Families interested in learning more about either program can contact Polly Scoutaris, 296-8024.

* * *

The Association of Energy Engineers (AEE) is a nonprofit professional society of 5300 members and 30 chapters. AEE members are active in reducing energy costs for the commercial, institutional, and industrial sectors. (A recent survey of AEE members indicated that 41 percent have slashed operating costs $1,000,000 or more and 45 percent have cut energy consumption by 20 percent or more. The opinion survey found that 62 percent of those surveyed had installed an energy management system and only 6 percent found performance unsatisfactory.)

For more information on AEE, contact AEE: 4025 Pleasantdale Road, Suite 340, Atlanta, Ga. 30340, (404) 447-5083.

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Want to become an ambassador of goodwill? The Friendship Force of Albuquerque is looking for recruits to join others in a trip to Israel June 1-15.

The Friendship Force is a private, nonprofit citizens' exchange program. Volunteer leaders in over 38 countries recruit groups to travel to a partner city in another nation. Cultural workshops prepare them for their experience. These same persons and others in their community serve as hosts when the group from the partner city visit for their half of the exchange. (The Israeli exchange group will be in Albuquerque in August.)

For those joining the Israel trip, the first week will be spent in a moshov, or farm coop village, near Tel Aviv. The estimated $1522 cost covers an optional $375 second phase that includes a stay in a kibbutz and a tour to the Dead Sea, Galilee, Masada, and Nazareth, spending one night near the Sea of Galilee and several days in Jerusalem. Alternatively, the second week may be spent in independent travel. There is an optional third and/or fourth week stopover in Europe, the city to be determined by the airline used.

For more information or applications, call the Friendship Force office, 243-6916 (10 a.m.-3 p.m. weekdays), or the exchange director Kay Lang (5211), 291-0650.

* * *

The Fifth Annual Earth Building Conference and Second Annual Earth/Energy Exhibition will be held March 29-April 1 at the Agricultural Exhibits Bldg. and Youth Conference Hall at the State Fairgrounds. Earth Systems Exposition '85 is sponsored by Earth Systems Development Institute and the NM Solar Energy Institute. The agenda includes earth-built structures, solar energy, rammed earth, pressed block, Navajo Indian housing, adobe, tiles, how-to books, corbels, insulation, hands-on demonstrations, alternative technologies, eco-development, owner-built homes, seismic risk, Miskitu Indians, socializing, woodworking, 40 exhibitors, and more.

Conference cost of $100 includes all events and conference materials. Exhibition and trade show only is $2 each day; home tour only, $10; demonstration day only, $2. Register before March 1 to avoid late registration fee. To register, contact ESDI, Box 1217, Corrales, NM, 897-2196.

* * *

UNM's Second Annual Computer Fair is underway today and tomorrow at the Ballroom of the NM Union Building. Held in conjunction with National Engineering Week, the fair will feature exhibits of the latest computer software and hardware, symposiums, and a teacher's forum. For more information, call 277-6296 or 277-2761.

* * *

If books tend to breed indiscriminately around your place and you'd like to find them a good home, how about rounding up those you no longer need or want and donating them to the South Highway 14 Village Project? The Project, which operates out off the LAB NEWS office, helps needy families in the villages on South 14 (Escabosa, Chilili, Tajique, Torreon, Manzano, and Punta). Donated books are resold at bookstands in Bldg. 892 and the LAB NEWS office. A third bookstand is planned for Bldg. 805. A receipt is written for book donors who wish one for tax purposes. Please bring your books to the LAB NEWS office in Bldg. 814; if you have too many to be carried, call Norma at 4-7841 to arrange for pickup.

* * *

UNM's geology department is offering free public lectures during the spring semester. Lectures will be held in room 122 of Northrop Hall on the main campus at 11 a.m. The schedule follows:

Feb. 21 — "Present Day Submarine Hydrothermal Systems: Links to the Precambrian," John Baross, Univ. of Wash.

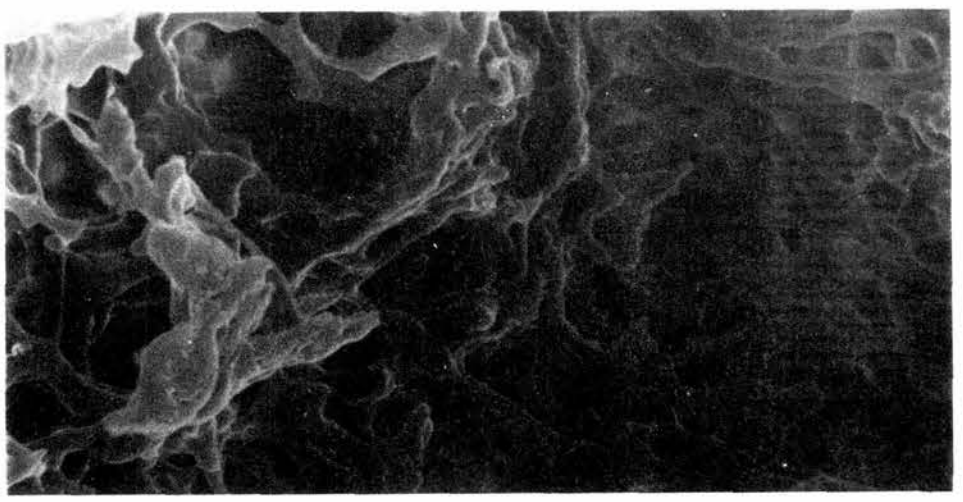
Feb. 28 — "Tertiary Evolution of Central Arizona ('Yo-Yo Tectonics')," James Faulds, UNM.

March 7 — "Archean Tonalites and the Origin of Continents," Kent Condie, NMIMT.

March 21 — "Stratigraphy and Depositional Environment of Lower Cretaceous Sedimentary Rocks in Southwestern New Mexico," Gregory Mach, NMSU.

March 28 — "The Archean Fossil Record: Recent Progress and Unsolved Problems," William Schopf, UCLA.

April 4 — "Palagonite Formation in Basaltic Glasses," Michael Jercinovic, UNM.



SCANNING ELECTRON MICROSCOPE photo reveals the structure of one of a new class of unique, low-density microcellular foams developed for applications in high-energy physics experiments. The foams are made by thermally phase separating a polymer solution, freezing the solution, and then freeze-drying to remove the solvent. Foams can be made with densities from 0.003 g/cc to 0.2 g/cc and cell sizes from 1 to 20 micrometers. (Research Sciences - 1810/1830)

materials such as Mylar doped with TNF (trinitrofluorenone) exhibit a pronounced reduction in the photocurrents generated upon exposure to ionizing radiation. The low radiation-induced conductivity coupled with the low melting temperature of these polymeric dielectrics allows capacitors made of these materials to satisfy both radiation hardness and nuclear safety requirements that are not attainable with other capacitor dielectrics. Through a joint program with Org. 2560, the development of these materials has moved rapidly from the materials research phase through fabrication and testing of capacitor components. The materials are now considered prime candidates for use in "weak link" capacitors in Phase 3 weapons programs. (1810)

• Intense, high-energy electron beams have potential applications as point defense weapons. However, there are major physics issues that must be resolved before this goal can be achieved. In particular, an electron beam propagating through air can be destabilized as a result of magnetic repulsion of the beam electrons by induced return currents (resulting from beam ionization) flowing in the plasma. The instability can take the form of an azimuthally symmetric hollowing, which has a predictable onset threshold, that is a function of air pressure and beam parameters. We have performed experiments with a quiescent beam that for the first time verified the existence of this instability when the air pressure was reduced below the predicted threshold. Complementary computer simulations have produced stationary wave mode patterns of the instability that were in striking agreement with experimental observations. Scaling laws based on these data indicate that more powerful electron beams will not have this instability. (1270)

• We have developed unique, low-density microcellular foams for applications in high-energy physics experiments. These foams are made by thermally phase separating a polymer solution, freezing the solution, and then freeze-drying in order to remove the solvent. Foams can be made with densities from 0.003 g/cc to 0.2 g/cc and cell sizes from 1 to 20 micrometers. Conventional foams typically have densities as low as 0.02 g/cc but have large cell sizes of 100 to 500 micrometers. The small cell size is imperative for the planned physics experiments, such as their use as laser rods in the laboratory x-ray laser being developed by Org. 1270. For polymer solutions whose phase diagram is understood, we have demonstrated an ability to control cell size by manipulating certain thermodynamic variables. (1810/8310)

• Amorphous metal alloys have corrosion and abrasion resistance far superior to their crystalline counterparts. Since corrosion and wear are phenomena associated with crystalline microstructure (i.e. grain boundaries, defects, phase segregation,, etc.), it is believed that the remarkable properties of amorphous metals are due, in part, to their lack of long-range order. We have developed a new technique for producing amorphous metal alloy coatings. This technique consists of using a radio frequency discharge to dissociate gaseous organometallics and metalloid hydrides in a reducing carrier gas. The method is quite general and should allow the formulation of amorphous metal alloy coatings for a variety of applications. (1830)

• In support of the Strategic Defense Initiative, a computational simulation has been developed to compute the rarefied gas dynamics, chemistry, and radiation within high-altitude rocket plumes. Based on a direct-simulation Monte-Carlo method, the computer code predicts the flowfield and radiation resulting from the interaction between booster exhaust gases and the high velocity free-stream air. This interaction region is referred to as the enhancement region. With our computer code we can, for the first time anywhere, compute the entire enhancement region flowfield for large-scale boosters. (8230)

Computing

• Under its charter as lead laboratory for Computer-Aided Design/Computer-Aided Manufacturing (CAD/CAM) Integration, Sandia has worked with CAD/CAM users throughout the Nuclear Weapons Complex (NWC) to transfer drawings using a neutral format for graphics data of the type found in CAD/CAM systems. Because of the many different CAD/CAM systems that exist at the various design and production agencies within the NWC, this work is essential to the successful transition to an electronic design and manufacturing environment. The transmission rate of drawings has risen to several hundred per month, making DOE one of the most active users in the transfer of drawings using the national graphics exchange standard. (7610)

• A primary objective of DOE's effort to integrate Computer-Aided Design/Computer-Aided Manufacturing (CAD/CAM) capabilities throughout the Nuclear Weapons Complex (NWC) is automating the exchange of product definition data. To assure that data integrity is preserved and verified during data exchange, we have developed the VERTRAN program ("VERification of TRANsferred data") that detects differences in the geometric data of a computer product definition file transferred from one CAD system to another. The framework program has been completed, and consultations are under way with NWC personnel for broad implementation. (7610)

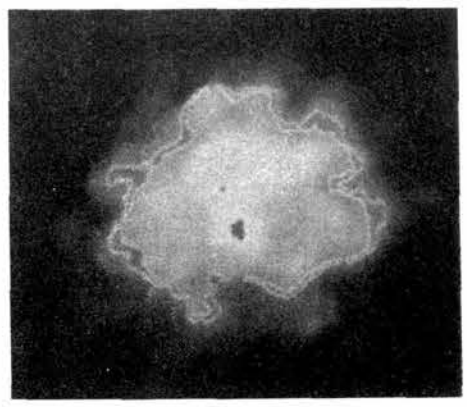
• We have developed and implemented a computerized system that provides production and design agencies in the NWC (nuclear weapon complex) with direct, on-line terminal access to certain engineering data stored in the Univac 1100/82 computer at Sandia. The Automated Engineering Release Information System (AERIS) provides both terminal displays and hard-copy reports of selected information from Engineering Releases (ERs) issued between 1974 and the present for any drawing number entered in the terminal. (7620)

• Org. 2600 developed image-processing techniques to support several diagnostic experiments for the particle beam fusion program. One set of diagnostic images obtained from a focused ion beam from the Applied-B diode, when processed and analyzed, indicated a breakthrough in beam focusing. These processed images were part of two national press releases on May 17. (2640)

• The Distributed Computing Network has grown to more than 50 nodes and extends to Sandia Livermore, Bendix Kansas City, and G.E. Pinellas. State-of-the-art fiber optic and Ethernet communications are being used in many parts of the network. Twenty distributed VAXes are now being supported by Org. 2600, of which seven are processing classified data using the security enhancements we developed. Security features in the new VAX/VMS 4.0 operating system were evaluated, with our security enhancements being converted to the new system. (2640)

• Improvements to the Sandia Albuquerque data communications system included the installation of 24 optical fibers to Bldg. 891, construction of microwave links from Areas II and V to Area I, and completion of new Tech Control Centers in Bldgs. 960 and 891. The latter represents the latest in diagnostic technology and is capable of remotely diagnosing circuit failures many miles away. As a master center it is also capable of network reconfiguration, a technique that places defective circuits and trunks off-line for repairs. (2630)

• Expansion of the Central Computing Network included connections to the CDC Cyber 76, the Cray-1S via its front-end machine (a CDC 6600 running NOS, new operating system) and 20 distributed VAXes via a pair of gateway machines. These machines now have access to the File Store and



MILESTONE PHOTO, created by the Computing Directorate 2600 with advanced image-processing techniques, indicated a breakthrough in beam focusing in the particle beam fusion program. The small focal spot size demonstrates Dept. 1260's ability to focus an ion beam onto the most demanding ICF (inertial confinement fusion) target — that to be used in PBFA II. (Computing - 2640)

the Output Node that supports the computer-output-microfilm equipment and laser printers. (2640)

• A Computer-Aided Engineering Laboratory has been established within the Computer-Aided Design and Integration Department for development and implementation of CAE capabilities to assist the design and design verification process.

The multipurpose lab is being used for workstation evaluation, staff training, and software interface development to serve the needs of the Sandia engineering organizations. (7610)

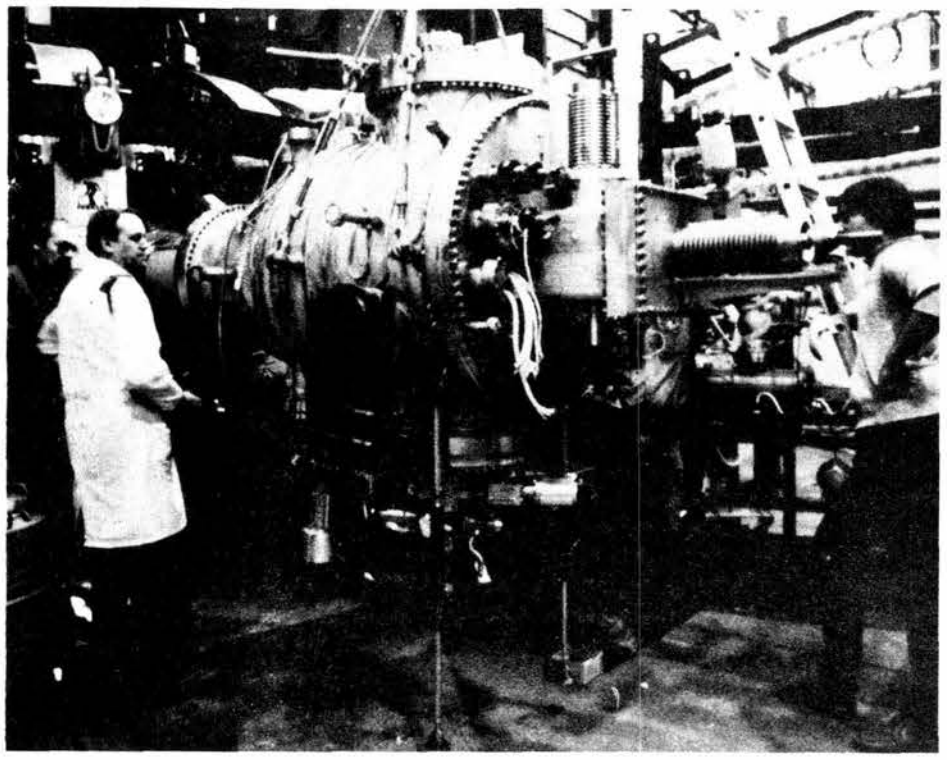
• We installed a video animation system that allows recording of computer-generated graphics output directly onto video cassettes. It can be used as a quick turnaround preview system before going to film or, if appropriate, the video cassettes can be used for final output. (2640)

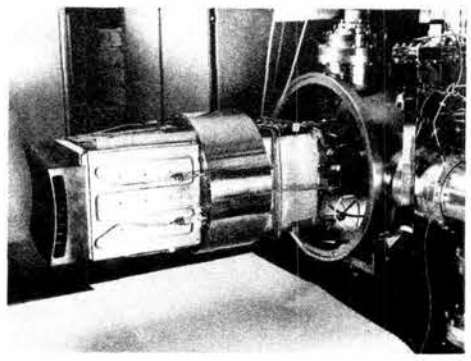
Energy

• The Molten Salt Electric Experiment at the Central Receiver Test Facility was finished in 1983, and startup was achieved in June 1984. The full system is operating, and electric output in excess of the rated 750 kW has been accomplished. Since June, performance and reliability testing has been in progress. Five electric utility teams have been trained onsite in the operation, and their feedback has provided valuable suggestions for improving operating procedures and hardware design. The project was officially dedicated on Sept. 13 with representatives present from the nine participating utilities and industries, DOE, the Electric Power Research Institute, and Sandia.

The experiment, connected to the Public Service Company of New Mexico utility grid, demonstrates the feasibility of using a molten nitrate salt for heat transfer and storage in a solar central receiver power plant. The system will continue to operate in an experimental mode during the coming year, with the current receiver replaced with an advanced design in the fall of 1985. (8450/6220)

• Under Sandia Livermore technical management, a two-year test and evaluation phase was successfully





THE ALT-1 (Advanced Limiter Test) module was installed at the TEXTOR fusion reactor tokamak at Juelich, Federal Republic of Germany. The unit controls plasma density by removing hydrogen without introducing excessive impurities. It provides new information on the physics of the plasma edge and on materials performance. Smaller photo is a closeup of the ALT-1 pump limiter module. (Energy -8340/6240/1830)

completed at the 10 MWe Solar Thermal Central Receiver Pilot Plant near Barstow, Calif. All major subsystems and the complete system were checked out, and data were gathered for performance analysis by Sandia. All design power goals have been met. The plant began a three-year period during which a utility will operate the plant to maximize the amount of electricity delivered to a commercial grid. A series of Sandia reports is being published to disseminate the results. (8450)

• We have made the first real-time measurements of mass burning rate in an operating pulse combustor using a novel OH chemiluminescence technique. The results are incorporated into a fully time-dependent fluid dynamic computer simulation. These pulse combustion devices have potential for capturing a large fraction of the domestic heating market because of their high thermal efficiencies (95 percent) and low NO_x levels — a factor of five below conventional designs. This research project addresses the critical scaling, noise, and heat transfer issues using guidance from domestic and international manufacturers in a cooperative working arrangement with other DOE national labs and several universities. (8360)

• Sandia's unique external ion/microbeam analysis facility was used for non-destructive analysis of limiters from major tokamaks in the United States and Germany. Limiters are the mechanical elements that define the plasma position in these fusion reactors, and this analysis is being used to gain new understanding of impurity generation, deposition, and plasma-induced erosion. The ion microbeam provides three-dimensional concentration profiles on micrometer scales, and the external ion beam analysis allows mapping over the surfaces of limiters with dimensions greater than a meter.

In related plasma-materials interaction studies, the hydrogen flux and energy at the plasma edge are being characterized with a new particle detector developed at Sandia. This probe uses the increase in electrical resistance of thin carbon films when they are bombarded with hydrogen isotopes to provide real-time measurements of the hydrogen flux and energy and has been used to characterize the plasmas in five major reactors. (1110)

• The Advanced Limiter Test (ALT-I) pump limiter experiment is being conducted at the TEXTOR fusion reactor tokamak at Juelich, Federal Republic of Germany. Under an International Energy Agency implementing agreement, we designed and built the first externally pumped module of this type and demonstrated its successful performance on a large tokamak device. The first studies have shown the module's utility in controlling plasma density by removing hydrogen without introducing excessive impurities. The ALT-I experiment has provided insight into important tokamak operating parameters, including new information on the physics of the plasma edge and on materials performance. This knowledge is now being used to design future pump limiters, which may be needed for plasma density control and helium "ash" removal in advanced power-producing fusion reactors. (8340/6240/1830)

• Horizontal-axis wind turbines can now be modeled with a new computer method. The new technique has advanced design capabilities for wind turbines, both in terms of accuracy and ease of use. It was the only method, among several industry and government computer programs, that could explain a major vibration observed in the rotor of the Boeing Mod 2, a large multi-million dollar research turbine developed with joint funding from DOE and NASA. The Sandia model is now being used by industry to design the next generation of horizontal turbines. (1520)

• Solar cell efficiency is a critical factor in improving the cost effectiveness of photovoltaics for electrical power generation. One approach that we are pursuing involves the use of multiple junction solar cells that have the potential for conversion efficiencies above 30 percent. An efficiency benchmark was recently established with a two-junction solar cell with a measured efficiency of 23.7 percent. The device consisted of a GaAs cell mechanically attached to the surface of a silicon cell. (6220)

• The full-scale system mock-up of the SPR III (Sandia Pulsed Reactor) RMR (Remote Maintenance Robot) system has been demonstrated. Objectives of the project are to significantly reduce occupational radiation exposure in maintenance/inspection operations on SPR III and to establish a technology base for other SNL/DOE programs. The system is composed of three major subsystems: an overhead programmed hoist, a programmed turntable, and a six-degree-of-freedom manipulator. The operator assumes a supervisory role for programmed operations and can take over manual control for unplanned tasks. The system is scheduled to be operational in Area V during FY85. (6220)

• We have achieved a new capability for simultaneously measuring the size, temperature, and velocity of reacting particles in a combustion environment. The new technique combines our novel image-plane coded-aperture method of particle sizing (patented in 1984) with ratio pyrometry, and measures velocity by transit timing. The technique allowed us to examine the oxidation of pure carbons where the temperature is very sensitive to particle size. It is now being used routinely in fundamental studies of the oxidation of coal char particles where the joint distribution of size and temperature is being measured to determine burning rates. (8360)

• As a part of Sandia's involvement in DOE's Enhanced Oil Recovery (EOR) program, we conducted field tests in Canada to evaluate various types of insulated tubing used to inject steam into heavy oil formations. Results indicated that heat losses were as much as six times higher than predicted, apparently due to an unanticipated process: wellbore refluxing. More recent tests at Sandia have conclusively proven the existence of refluxing and have indicated how it can be prevented. These results have been transferred to industry, and we estimate that the relatively inexpensive solution may save up to a billion dollars in fuel costs alone over the next decade. (6250)

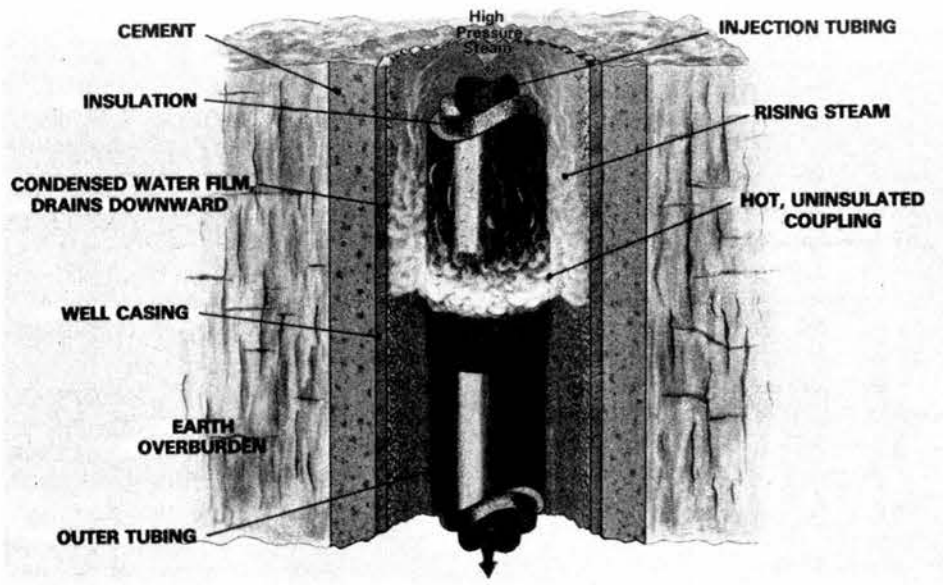
• A study of sooting laminar diffusion flames at ambient and elevated pressures using laser light-scattering techniques shows that the size, number, and total mass of soot particles formed increase with pressure. Laser Doppler anemometry was used to measure the flow field in the flames, permitting the determination of the local rates of soot production. These important results help identify the physical mechanisms responsible for increased production of soot at elevated pressures — as occurs in internal combustion engines. (8350)

• An extensive study established the feasibility of reducing the construction time of a nuclear waste repository. We examined concepts for receiving and emplacing waste at the Yucca Mountain site in Nevada. Initial receipt rates of 400 metric tonnes (MTU) per year were considered in a first-phase small facility with an ultimate capacity of 3000 MTU per year in a second, larger facility. The study showed that by constructing the small, simple, waste-handling building and the major handling facility at the same time, the waste can be received three years earlier than without the small facility. The considerably more complex large facility has several production lines where the spent fuel can be disassembled and packaged; the small facility has only one receiving and packaging line with no disassembly capability. The cost increase for the additional facility is approximately $100 million, less than 10 percent of the total of approximately $1,130 million for the initial construction. (6310)

• We provided a major input to the environmental assessment supporting the potential nomination of Yucca Mountain as a site for the nation's first nuclear waste repository. The document was released to the public late in 1984 and will be subject to wide review and comment before the final decision on sites to be characterized is made by the DOE and, ultimately, the President. Our inputs included descriptions of the repository and preliminary evaluations of the performance of the system in terms of regulatory standards. Engineering evaluations provided assessments of the ability to construct, operate, and decommission the repository relative to the DOE's guidelines for site selection. Calculations of groundwater movement and radionuclide transport allowed preliminary comparisons of cumulative release of radioactivity to the accessible environment with standards proposed by the Environmental Protection Agency. This work required completion of about 30 SAND reports as supporting sources. (6310)

• The Subseabed Disposal Program has developed a one-of-a-kind capability to predict physical oceanic responses using a hierarchical series of oceanic models with increasing space and time scales. This development may be useful to the Navy as well. The models predict movement of contaminants released from a possible subseabed repository through the oceans of the world. In addition, the models address important anti-submarine warfare issues. Although our existing data set is the best in the world, it will be supplemented during the next year with data from a naval satellite (GEOSAT). (6330)

• The *In Situ* Test Program for the Waste Isolation Pilot Plant (WIPP) has progressed from the planning and design phases to construction and installation of the tests in the underground salt formation near Carlsbad, NM. The tests address the effects of salt creep (including the effects of waste heat) on underground openings and the performance of full-scale nonradioactive defense waste packages; the tests also allow the evaluation of designs for the seals for site characterization boreholes, underground haulage ways, and waste storage rooms. These tests, involving more than 4000 channels of data, will be conducted for several years. They will provide an important data base for evaluating the design and waste isolation performance for WIPP and future nuclear waste repositories in salt. (6330)



WELLBORE REFLUXING — the cause of undesirable heat losses during injection of steam that allows the recovery of heavy oil — is illustrated in this drawing. Sandia developed a method of preventing this heat loss and transferred it to industry. The inexpensive solution will save an estimated billion dollars in fuel costs over the next decade. (Energy - 6250)

• We now have the capability to use isotope-ratio mass spectrometry to determine paleotemperatures, mineral origins, details of rock-water interactions, and sources of water in natural geologic systems. The immediate applications are related to studies of the long-term dynamic geologic processes near the WIPP site, but precise measurements of isotope ratios are useful in a wide spectrum of geochemistry. With our system, the ratios of isotopes of carbon, oxygen, hydrogen, nitrogen, and sulfur can be measured with a precision of one part in several million, a precision much higher than that obtainable by conventional mass spectrometry. (6330)

• Chemically selective polymeric membranes are required to achieve high energy efficiencies in advanced, redox-system secondary batteries. The chemically aggressive nature of the electrolytes used in these batteries produces catastrophic degradation of conventional commercial membranes. We have developed sulfonated polysulfone membranes that are resistant to attack by electrolytes. At the same time, these membranes also satisfied the efficiency requirements of the batteries being developed. This work strongly supports the development and commercialization possibilities of several advanced secondary battery systems. (2520/1810)

• We completed the first phase — demonstration of feasibility — in the development of an adjustable buoyancy balloon tracer of atmospheric motion by proposing an overall systems design, by carrying out theoretical analysis on that design, and by fabricating and testing a prototype. The adjustable buoyancy balloon tracer is a marker for atmospheric flows. With a lifetime of more than three days, it can follow motion in the vertical direction as well as the horizontal, and can be tracked worldwide by satellite. It is being developed for the Environmental Protection Agency's Acid Rain program to test long-range transport models. It also has broad applicability elsewhere in the atmospheric sciences. (6320)

• We completed a Heated Block Experiment in G-tunnel at the Nevada Test Site in September. The experiment was an important step in evaluating the appropriateness of welded tuff formations for use as a radioactive waste repository. To permit measurements, the block (~2m x 2m 3m deep) was isolated by cutting slots in the floor of a mined room at a depth of 420 meters in welded tuff beneath Rainier Mesa. Rock temperatures of up to 150°C and applied stresses of 1700 psi were experienced by the block during the 30 months of data gathering. The test provided the first large-scale data for evaluating the fracture permeability, mass modulus, Poisson's ratio, and thermal expansion of welded tuff. Additional data were also provided on the effect of stress and temperature changes on water movement and ultrasonic wave velocities. (6310)

• Sandia's Geoscience Research Drilling Office has lead lab responsibilities for providing drilling and instrumentation technology to geoscientists using drilling as a research tool. In 1984, the Drilling Office supported research in Long Valley, Calif., by drilling through a 600-year-old magma conduit and by drilling through a basalt dike into a major fault. Borehole instrumentation is being developed for geoscience research and transfer to the scientific community as well as industry. (6240)

• In an attempt to study the internal plumbing of volcanoes, drill holes were cored into the conduit that fed a major volcanic eruption in California 600 years ago, and also into the large underlying dike, or sheet-like intrusion, connecting to the magma chamber below. The holes are the first to directly sample the plumbing of a very young volcano that has not undergone extensive alteration and weathering, and are providing new information about how magma behaves in the upper crust. Scientists from four DOE labs, four universities, and the U.S. Geological Survey participated in the field operation, which was coordinated by Sandia. An understanding of volcanism is necessary for the efficient extraction of energy from geothermal systems. (1540)

Testing

• We developed a number of new predictive models and diagnostic instruments for measuring conditions during and following underground nuclear tests (UGT). These include: a method to measure the volume of the explosively formed cavity without mineback; tailored-response measurement systems for detecting early time cavity temperature and pressure history following the detonation; and a computational procedure for predicting the flow of gas (and resulting temperature and pressure fields) in a layer of sand in a cavity in a UGT. The model predictions are being used to locate instrumentation on UGTs. (7110)

• Tonopah Test Range (TTR) completed a full schedule of 260 tests. Two new capabilities have been installed to improve efficiency: an array of 21 geophones that can determine impact location of anomalous trajectory projectiles; and 25 kilometers of fiber optic cable between the operations center, Area 9, and three fixed radar sites to transmit video, tracking data, and timing. (7170)

• A new test facility that measures radar cross sections and performs target imaging of up to 6-foot targets has been constructed in Area Y. The facility employs a 1200-foot inverted vee concrete range to minimize terrain reflections and a 100-foot air-supported temporary structure for security protection. A sophisticated coherent pulsed radar provides wide-band target characterization in four operating bands. On-site computer FFT (fast Fourier transform) processing of wide-band measurements provides near real-time target imaging with exceptional resolution. (2340/1650)

• The Laser Tracker-II (LT-II) instrumentation trailer advances the art of high-speed tracking by a factor of three to ten. This unit provides photometric coverage, trajectory data, and range control for tests conducted at the Area III rocket sled and aerial cable facilities. Using a state-of-the-art agile gimballed mirror, targets traveling at 13,600 mph are tracked with an accuracy of 6/10ths of an inch. When deployed in 1985, LT-II will support testing of delivery systems and a variety of reimbursable weapons programs. (7521)

• High-velocity rocket sled and explosively driven flyer plate technologies were combined to provide a 15,000 foot-per-second (fps) impact capability for testing reentry vehicle contact fuzes. The fuze is accelerated on a rocket sled to a velocity of 6000 fps. As the rocket sled approaches the end of the sled track, it triggers an explosive charge that accelerates a flyer plate target to 9000 fps, impacting the fuze at a combined velocity of 15,000 fps. Impact conditions are verified by flash x-ray, and fuze output is transmitted from the moving sled via a hard-wire contact. This technique is being proposed for warhead crushup tests involving full reentry vehicles. (7530)

Reimbursables

• We completed a system proof-of-concept demonstration for an Enduring Nuclear Detonation Detection System (ENDS) for the DoD. The demonstration used ground-based and satellite-based sensors to time-tag the arrival of optical and electromagnetic pulse signals from a simulated nuclear detonation. Time-tag data were automatically relayed to an ENDS terminal where event location calculations were performed and user event messages were generated and transmitted via enduring communication links. (5320)

• The preliminary design and testing of a terrain-aided navigation algorithm for use on low-level attack aircraft was completed for the Air Force. The algorithm, called AFTI/SITAN, is an extension of our previous work in terrain-aided navigation and will be flight tested on the Advanced Fighter Technology Integration (AFTI) F16 aircraft during 1985. The AFTI/SITAN code refines the aircraft position and velocity estimates produced by the aircraft inertial navigation system by processing radar altimeter ground clearance measurements in conjunction with Digital Terrain Elevation Data. Initial flight testing over cartographic maps has shown accuracy better than 100 meters. (5340)

• In March, Sandia was requested by the Ballistic Missile Office to provide blast testing environments for the Air Force Hardened Mobile Launcher (HML) development. This testing program involves four contractors from which the Air Force will select one for the new small ICBM launcher. By early September we had completed a major extension to our 19-foot-diameter explosively driven shock tube, making it a 520-foot-long facility, the largest blast simulator in the US. Explosive-driver charges up to 1000 pounds were used to provide model test environments in a series that was completed ahead of schedule on Nov. 2. (7530)

• As part of the Homing Overlay Experiment (HOE), the US Army's Ballistic Missile Defense Command conducted a series of four exoatmospheric defensive intercept experiments. In the last test, an interceptor rocket, launched from Kwajalein Missile Range, successfully guided itself on a collision course with, and destroyed, a reentry vehicle (RV) that was traveling on an ICBM trajectory over the Pacific Ocean. We furnished the RV targets and instrumented them to measure absolute attitude, position, temperature, and impact location. This test series culminated in a spectacular demonstration of the homing interceptor. (1650)

• We completed the development, deployment, and checkout of three ground receiving and data processing stations that provide real-time nuclear burst reporting capability support for Global Positioning System/NUDET Detection System (GPS/NDS) Block I satellites. These stations are located at Clark AFB, the Philippines; Ascension Island; and Vandenberg AFB, Calif. Each is capable of tracking up to four satellites simultaneously. Data are autonomously processed and relayed to user terminals for analysis and display. This work for the DoD formed the basis for a continuing effort to develop more comprehensive ground stations to support the GPS/NDS Block II 18 satellite operational system. (5320)

• We developed a capability for simulating ground-water flow and the transport of dissolved species through fractured rock formations. Two computer codes, the Sandia Waste Isola-

tion Flow and Transport (SWIFT) code and Network Flow and Transport/Distributed Velocity Method (NWFT/DVM) code, were modified to simulate transport of dissolved radionuclides through fractured rock with possible diffusion into the surrounding rock matrix. These codes are part of a detailed Performance Assessment Methodology developed for the use of the US Nuclear Regulatory Commission (NRC) in evaluating high-level radioactive waste repositories in deep geologic formations. This methodology is being used by the NRC and Environmental Protection Agency (EPA) to develop regulations and standards for geologic disposal of radioactive wastes. (6430)

• We have developed a Weapon Storage and Security System (WS^3) for the Air Force for use in improving the security and survivability of tactical nuclear weapons. The system includes a hardened in-ground vault with electromechanical elevating features operated by a microprocessor-based controller. Vault status is reported to a central monitoring location over a secure fiber optic link. Information is displayed on a touch-screen video display terminal. An assessment system is integrated with the communication and display equipment to provide automatic video coverage of vaults that report alarms. (5230)

• In support of the US Army Weapons Access delay System (WADS) program, we provided detailed designs and initial hardware to the Army for use in protection of munitions at European military sites. In addition, we assisted in the installation and training at the initial site; detailed installation procedures, maintenance manuals, and site acceptance procedures were provided. (5210)

• We have completed a prototype of a Missile Secure Cryptographic Unit (MSCU), which processes missile launch messages. The MSCU architecture uses triply redundant microprocessors in combination with majority-logic voting to ensure high reliability and to protect against inadvertent disclosure of sensitive information stored within the unit. Software is written in the high-level language FORTH; this language choice facilitated code development and permitted the MSCU to be completed on schedule with the critical functionality requested. (2310)

• We have developed models for estimating the ecomonic risks from US light water reactor (LWR) operation. The models estimate both onsite and offsite economic consequences of events ranging from routine plant outages to severe accidents accompanied by releases of radioactive material to the environment. Example applications of the models showed that, in contrast to public health risks, the economic risks from US LWR operation are dominated by routine forced outage events. The models, developed for NRC, have supported cost-benefit analyses and decision making in both the nuclear power industry and regulatory agencies. (6410)

• We have developed a code and conducted experiments, including two major tests on the Annular Core Research Reactor (ACRR), to understand and describe the progression of nuclear power reactor core melt accidents. Intact fuel rod bundles were severely damaged in tests on the ACRR to provide data on clad oxidation, hydrogen production, fuel melt progression, fission product release, and transport for use in model developement and verification. Another major test series involved studies of the coolability of severely damaged reactor cores. The first version of the computer code, MELPROG, has been released for reactor safety analysis. (6420)

• Studies of potential threats to reactor containment from hydrogen burning and explosions continued with the completion of a new large-scale test facility, Flame. A number of tests were conducted in Flame to determine the conditions under which hydrogen burns can become detonations. Tests in other facilities provided further data to describe physical conditions leading to deflagrations and detonations under conditions expected in a severe nuclear power plant accident. A computer code, HECTR, which predicts containment responses under severe accident conditions, was released for general use in safety analysis. (6420)

• As part of a national effort to better predict the release of radioactivity to the environment in the event of a severe reactor accident, we developed an advanced thermal chemical model that predicts fission product release from interactions of molten reactor materials with containment structures. Numerous large-scale core melt/concrete interactions tests were conducted using the recently operational Large Melt Facility to provide first-of-a-kind data with real reactor core materials. These tests, along with a number of smaller scale experiments, provided a comprehensive data base of the thermodynamics that drive the release of fission products as well as the kinetic rate-limiting processes that retard their release. These results have been used by the NRC to reevaluate severe accident radioactive "source terms" for a number of US nuclear power plants. (6420)

• We have conducted research to find methods to reduce the rate at which alarms are activated during transients at nuclear power plants. Using the alarm system of the Arkansas Nuclear One Unit as an example, we found that several hundred alarms were activated during a simulated loss-of-coolant accident. One alarm rate reduction method being investigated is to delay secondary alarms for several minutes to give operators time to respond to important alarms in a controlled manner. The Public Service Company of New Hampshire is incorporating some of the alarm frequency reduction methods into its Seabrook Station nuclear power plant, and the Central Electricity Generating Board of Great Britain is interested in applying the methods. (6430)

• A 1/8 scale model of a power reactor steel containment building has been successfully tested. The test was part of a set of programs that are being conducted for the NRC to study the performance of light water reactor containment buildings when subjected to internal overpressurization due to severe accident loads (i.e. those beyond current design requirements). The model, which was 14 ft. in diameter and 21.5 ft. high, was designed and fabricated according to American Society of Mechanical Engineers (ASME) code for a design pressure of 40 psi (gage). Data were recorded at each pressure increment until the model ruptured at 195 psi (gage). The data obtained from the test will be used to validate computer programs that can then be used to predict the performance of full-size containments. (6440)

Treaty Verification Technologies

• The Norwegian Regional Seismic Array (NRSA), a cooperative effort of the Norwegian and US governments, was deployed during the summer near Hamar, Norway, in an effort to improve our ability to detect nuclear explosions. As directed by DOE, Sandia is responsible for the definition, design, development, deployment, and operation of the instrumentation, electronics, and communications for NRSA. This unique unmanned seismic array detection system is supplying real-time, high-quality data to four analysis centers -- one in Norway and three in the US via a two-hop satellite transmission link. The system was deployed on schedule and within budget. The data being analyzed at the System Control and Receiving Station (SCARS) in Albuquerque indicate that the NRSA is so far performing flawlessly. (320)

• The last two VELA satellites were quietly turned off on Sept. 27 after 14 years of continuous service. In all, a total of 12 VELAs were launched beginning in 1963. Although the predicted operating lifetime was only a few months for the first satellites, all 12 proved to be long-lived and reliable. Always launched in pairs into 72,000-mile-radius circular orbits, they were a joint DoD/DOE program to develop the capability to detect nuclear bursts in space, which are forbidden by the Limited Test Ban Treaty. However, the last six satellites also had earth-pointing optical sensors capable of monitoring atmospheric bursts. Throughout the program, Los Alamos National Laboratory was responsible for the space-burst sensors and Sandia for all data processing and power conditioning electronics, and for the optical sensors on the later satellites.

Several discoveries have resulted from the VELA instruments, including the occurrence of rare "super-bolts" of lightning and of naturally occurring gamma-ray bursts from objects in space.

Instrumentation developed for VELA has been adapted for use on modern programs such as the Global Positioning System of satellites. (5310)

• Two Global Positioning System (GPS) satellites carrying Sandia instrumentation were launched during 1984. They were the second and third GPS satellites capable of detecting nuclear detonations (to verify compliance with the Limited Test Ban Treaty). The detection systems include a Sandia-designed optical fireball sensor and a microcomputer that collects and processes the data for relay to ground receiving stations. All three satellites are in circular orbits 10,900 nautical miles above the earth's surface in an environment that requires radiation-hardened electronic parts, many of them supplied by the Center for Radiation-hardened Microelectronics. An eventual constellation of 18 GPS satellites will provide a full-time worldwide nuclear burst detection and navigation capability. (5310)

Pulsed Power Development

• The Particle Beam Fusion Accelerator II (PBFA II), scheduled for initial operation in January 1986, will have a power output in excess of 100 TW coming from 36 pulsed power modules. The final test phase of a single-module demonstration experiment, DEMON, has validated component designs for PBFA II. The DEMON module delivers 130 kJ of energy, in a 50 ns power pulse, to a matched transmission line load. Module timing uncertainty, which is a crucial factor in successful operation of a multi-module machine, is less than 2 ns standard deviation. Parameters have met or exceeded design specifications, so that PBFA II is expected to achieve its design goals of over 100 TW output power. (1250)

• MABE is the technology development testbed for Hermes III, the new gamma-ray weapons effect simulator being developed by Sandia to meet the DOE simulation requirements in the 1990s. MABE is a multiple beam linear induction accelerator and has produced the highest current ever achieved in this type of accelerator. As part of the MABE program, a high current single beam, 90 kA at 8 MeV, has been produced. In addition, to investigate the multiple beam concept, a nine-beam injector has been successfully tested. This multi-beam MABE injector produced nine 1.7 MeV, 25 kA beams. Seven of these beams were transported through an accelerator section, producing a total current of 175 kA, at 3.4 MeV. The experiment to acelerate all nine beams to 8 MeV is being assembled. Demonstration of the acceleration of nine beams to 8 MeV through an injector and three accelerating gaps will demonstrate the feasibility of the multiple beam Hermes III concept. (1240)

• An ion beam focusing experiment made major advances for the inertial confinement fusion program. Using the Proto-I accelerator, we developed new diagnostic and beam propagation techniques to fine-tune an ion diode focus. We achieved a proton beam focal intensity of approximately 1.5 TW/cm^2, with an ion radial convergence of 70:1. The small focal spot size achieved in this experiment indicated that intense ion beams can be focused, and served as a "proof of principle" demonstration of the ability to focus an ion beam onto the most demanding ICF target -- the 3 mm-radius target to be used on PBFA II. (1260)

of. I think the combustion lab at our Livermore facility is one of the most successful new enterprises in applied science in this country. We have used laser techniques to answer a whole range of questions in combustion that were previously poorly understood, and we have had enormous success and enormous spinoff into the private sector.

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I think our work in materials, exemplified by the strained-layer superlattice, is another example of a very successful program over the years.

We're playing a major role in nuclear reactor safety work for the NRC, and we have done some outstanding work in the solar thermal field. Currently, our work with particle beams suggests that we have as good a chance as any lab in the world to succeed at inertial confinement fusion.

SLN: What major new roles are we getting into now?

GCD: We're doing a great deal in the verification of treaties. The general idea is that the nation ought to negotiate treaties that are in fact verifiable by some sort of technical means. We're investigating those means, that is, the technical aspects of verification, not the political.

SLN: That takes pretty close ties with the arms control people in Washington, does it not?

GCD: Yes, we have two Sandians there now. That means we can report some success in the matter that I mentioned a year or so ago — that we ought somehow to have greater coupling of the scientific community with the arms control process so that we begin to negotiate treaties that we can verify.

SLN: Whom do we have in Washington?

GCD: We have two very good people, George Look and Clyde Layne [SNLL], serving in an advisory capacity in the arms control work at the DoD. Yes, I think we're all getting more credibility and more involvement at an earlier stage, and that's all to the good. And it's growth industry for Sandia: as the world

We have established a good reputation, so we are now besieged with opportunities to apply these technologies to important national missions of various sorts. We are in a kind of seller's market.

finally recognizes that it's to everyone's advantage to have a less warlike kind of atmosphere, then the matter of assuring that those agreements are workable will become a bigger problem, and we will be involved in it right up to our armpits.

SLN: A few years ago we were seeking reimbursable work. Now there's some concern that reimbursables are interfering with our major mission. Do you see any problem here?

GCD: Reimbursables never get in way of our mission because we are determined to manage things in such a way that they do not. We use reimbursables to couple our capabilities to national interests when there is manpower available from our major mission, and we use them to take up the slack as our major mission fluctuates in intensity. There has been no instance in which a reimbursable has interfered with our ability to do our major mission. That goes without saying.

However, we have established a good reputation, so we are now besieged with opportunities to apply these technologies to important national missions of various sorts. We are in a kind of seller's market. As you mention, that's in contrast to the situation 10 years ago when, after a series of layoffs and deep budget cuts, we were seeking reimbursable money.

But the kind of situation that was true in the 70s is not true in the 80s. We now have a much greater ability to pick and choose. We're choosing those programs that will optimize the total program of the Laboratories, which means that we accept those reimbursables that have a strong synergistic relationship to the other work we are doing and that have a growth possiblity for the future.

SLN: Are there new management mechanisms to deal with that — NSAC, for example?

GCD: We are now looking to our new NSAC [National Security Advisory Committee], chaired by Orval Jones, to consider reimbursables with a broader view than just "Can we do it, and is there money available to do it?" but also to ask "And should we do it for reasons having to do with these broad concerns of the future?"

SLN: You say we are besieged with opportunity. What in your opinion makes us attractive to the sources of reimbursable funding?

GCD: I think that the DoD and other agencies look to Sandia for work because they see here some unique capabilities, developed as part of our major mission, that they don't see elsewhere. Organizations that have continued long-range, level-of-effort funding in research and development, like Sandia or IBM or Bell Labs, can build a technology base over many years. Such laboratories wind up with a spectrum of technology that is more balanced and more on the forefront, more on the leading edge, than those that must seek each project as a separate proposal.

Thus it is not an accident that some laboratories have a more attractive market basket of technology than others. We happen to be one of these labs — we have a very attractive market basket of multidisciplinary technologies that can be put together to complete, in a fairly short time and in a very expeditious way, projects on the leading edge of R&D that would be hard to do elsewhere.

SLN: The outlook for our energy programs is not as rosy as for defense-related reimbursables. Why?

GCD: You're right. We said it last year and we have to say it again this year — there isn't any doubt that the energy program is decreasing. It's simply not perceived as a national imperative in the budgetary atmosphere. On the other hand, if you look at the objective facts of the energy supply, it's clear that the need for future energy sources is greater than ever. Political conditions make it appear that there's a glut of petroleum, but that's a very temporary situation. It seems to me that our energy research ought to be proceeding right along and not be as subject to ups and downs as it has been.

SLN: What kind of program would you suggest?

GCD: It ought to be a national program that would look at the potential sources of energy for future generations in a realistic way and somehow apportion its R&D programs to those energy sources most important for the future. If that were done, we would be spending much more money on coal research because we have lots of coal, hundreds of years worth.

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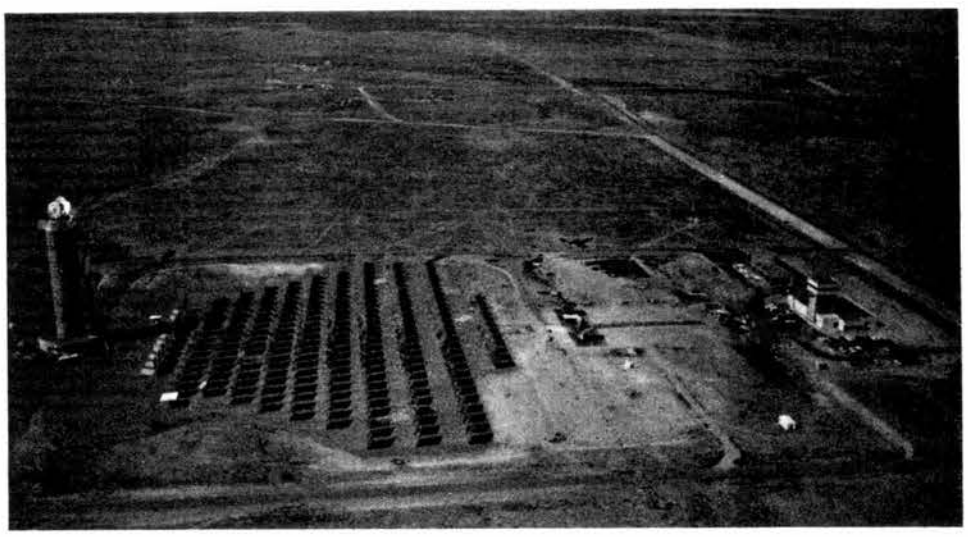
SLN: If that were to come about, it would give our fundamental work in combustion a very important role to play, wouldn't it?

GCD: It certainly would. After all, when you are concerned with fuels in general rather than with direct conversion of photons into energy, you are talk-



"WE HAVE DONE SOME OUTSTANDING WORK in the solar thermal field," says President Dacey. One example of that work is the Molten Salt Experiment at the Central Receiver Test Facility in Area III. The ongoing experiment demonstrates the use of molten nitrate salt as a heat transfer and storage medium for solar-generated electricity. The power is fed into the Public Service Company of New Mexico power grid. Other exemplary Sandia programs mentioned by Dacey include the combustion lab at Livermore, materials research (particularly the strained-layer superlattice), nuclear reactor safety work, and inertial confinement fusion.

ing about a combustion process. And how you burn coal has got to be an important clue as to how you avoid pollutants and acid rain and all the other problems that come about as a result of present-day coal combustion.

SLN: Do you think such a program is likely to ever come about?

GCD: I think we will see — as a realization of future energy problems once again reaches the public consciousness — a resurgence of energy research in general. But I don't see that happening over the next couple of years. I don't see that happening over the next couple of years. But I don't see that happening over the next couple of years.

SLN: What is our strategy for being ready when the time comes?

GCD: Our strategy is to keep as much of the relevant technology alive and keep as many of our programs healthy — at least at a low level — as possible. That way, when and if the country begins once again to emphasize energy research, we will be there with the people and the technology that's needed.

We're doing the same thing in reactor safety. The country has killed the breeder reactor, but it can't go on forever without advanced reactor technology, and other countries are certainly moving ahead. Again, we are keeping our reactor safety capabilities together during this uncertain time.

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SLN: Speaking of uncertain times, Paul Stanford's State of the Budget message [see "State of the Budget"] suggests that the FY86 budget is "iffy." Do you think that a budget squeeze is going to go beyond energy programs?

GCD: We certainly have seen — and are going to see in 86, I think — a substantial decrease in the federal funding for energy R&D. We have managed to deal with decreases fairly smoothly over the past three or four years: the expanding weapon programs required the same skills as the energy programs had, so weapons took up the slack as energy decreased. If the energy programs were to decrease precipitously and if there were no further increase in the weapon programs — and it's unlikely there would be — then we could have a problem of dislocation.

We're concerned about that for 86. We may have to have a more restrictive hiring program during 85 than was true for the last couple of years or so; the one thing we do not want to do is to find ourselves overstaffed in a period of shrinking budgets.

SLN: Do you feel that potential problem can be managed in that way?

GCD: If there were an enormous slash in the budget, that would be a problem we wouldn't be able to cope with. We don't foresee anything that drastic. But as the budget-balancing process gets underway, as the elimination of deficits becomes a bigger priority for the administration over the next year or two, I think it is bound ultimately to affect our budget.

The earliest indications we have are that the energy program is going to get hit first. The President's submission for 86 — as you know from Paul Stanford — does cut heavily into some of the energy programs, primarily in ICF [inertial confinement fusion], fossil, and solar. How that will finally wind up when it goes through the Congressional budgetary process we can't know yet. But I can't imagine its suddenly getting enormously bigger; if anything it's going to go down.

SLN: Can the weapons program budget serve as a kind of counterbalance here?

GCD: President Reagan seems to be resolved to increase the defense expenditure. Whether he will succeed or not I don't know. But I think there is every reason to believe he's not going to decrease the general level of defense activity. All the indications are that he'll make every effort to keep the funding at least level. Congress will react to that, of course, so we can't tell until we get around to it.

SLN: If both energy and weapons budgets get cut significantly, what fallback position do we have?

GCD: We currently have a large backlog of technology that is applicable to the present set of military problems. Perhaps in an unprecedented way, the confluence of concerns that were relevant to our nuclear programs of the past (on the one hand) and the present interests of the rest of the DoD (on the other hand) are so close that we are now being besieged with more requests from DoD agencies for us to do work for them than at any time in our history.

One other bright spot in a sky clouded by threats of budget cuts: we are contracting out more work than we have ever done before. Certainly if need be, we can bring in a lot of that work. We're in pretty good shape.

So I'm not unduly concerned about our ability to cope with budgetary fluctuations. It is entirely possible we'll have some in 86, and I think it will be prudent to have a very carefully controlled hiring program in 85.

SLN: Suppose we face more than budget fluctuations. Suppose that Congress decides to attack the deficit problem directly and really slashes the budget. What then?

GCD: If we were to have a very major cut in our programs, we would have to cope with that at the time; it could be a very serious matter for us. At the same time, I can't imagine the nation being so foolish as to cut its nuclear program by such an amount as to endanger it. I think that for the foreseeable future, in the world in which we live, a strategic deterrent and the support of our allies are going to be important to our national security. I can't imagine that the country, in the name of economy or the name of budget cutting, would destroy that capability. Austerity perhaps, but destruction no, in my view.

I can't imagine the nation being so foolish as to cut its nuclear program by such an amount as to endanger it.

SLN: You mentioned that we plan a more restrictive hiring program in 1985. And there seems to be some concern around the Labs that the lack of new Phase 3s could mean that we won't have enough work in 86 and 87. Is there any justification for that?

GCD: It's always a concern, because the government *may* decide to make a major cut in one of its programs. We've observed similar gyrations in the past. So we don't want to get ourselves overextended in terms of the number of people on-roll. The other side of that coin is our very large loss through retirements. We expect 600 to 800 people to leave this fiscal year. That's a lot of people so it gives us a lot of leeway in handling reductions.

SLN: In 84, we had the largest hiring program we've ever had. Did we have any problem in attracting good people?

GCD: No. We have had some very good people coming in. I think that the combination of our existing personnel, of the work we have to offer, of Albuquerque and Livermore as attractive locations means that we can certainly acquire the top people that we need.

SLN: What does our hiring program this year look like?

GCD: For the reasons we discussed a moment ago, I think it's unlikely that we'll have a large hiring program this year. But we certainly will be replacing some losses and we will certainly not be turning down any people who are too good to miss.

Austerity perhaps, but destruction no.

SLN: We've grown in population pretty rapidly over the last couple of years. What are the implications of that?

GCD: I think we need to relate the overall size of Sandia to the optimal use by people of facilities and equipment more explicitly than we have in the past. We don't want to hire more people than we have buildings to put them in nor than we have equipment to support them with.

So we must continue to plan our growth, if any, in terms of several other parameters: 1) whether we have missions that are valuable and relevant and coordinated and synergistic, which would justify growth, 2) whether we can foresee the buildings, facilities, and equipment to support new programs if we were to accept additional programs, 3) whether the funding and the expectations of these programs over time are stable enough not to create up-and-down kinds of problems for the future. So there are many elements in considering what the overall size of the laboratory should be other than just "Can we afford more people this year?"

Our attitude is to take a conservative view and not to grow rapidly or to shrink rapidly. We have had a growth of about 300 people in the last couple of years. We're up to 8400, in part because of the growth of the weapon program and in part because of the growth in reimbursables. But 300 people is a whole building, and we find ourselves in very much the same tight space problem that we were in a couple of years ago. The limiting factor in any future growth of Sandia will not be the lack of important missions nor any lack of appreciation of our strong capability of forming such missions, but rather the reasonableness of "How can you do work efficiently in terms of the whole spectrum of resources that are needed to carry out that work?"

Our five-year plan, therefore, does not contemplate growth beyond 8400. That's our target figure for the next several years.

SLN: Does that include contract employees?

GCD: That topic won the "Most Misunderstood Issue of the Year" award last year; I sometimes regret having ever discussed it. But my view, and the view of the Small Staff, on the use of contractor employees is not negative; it's positive. It's not that we shouldn't have any; we certainly should have contract employees in some areas. It is that we ought to use contract employees where it is appropriate and better to do so and not use them where it is inappropriate and wrong to do so.

Specifically, where Sandia's involvement is at the highest technical level, where a person is representing Sandia to the rest of the world, that activity is best accomplished by a member of our staff. We don't want to become a kind of a contracting agency. We are a laboratory. In some instances, we have found contractor employees doing work that ought to be done by members of the staff. There may be other areas where staff members have done work that could have been done more efficiently by a contractor who specializes in that area. That's what we're reviewing, with the goal of reversing the situation where necessary.

SLN: What reaction did you have to the Peterfreund Associates study of communications at Sandia?

GCD: It was very reassuring. We had the study performed because of my concern that our communication process was perhaps not as good as it ought to be. There had been a few isolated incidences where management actions had occurred without a full explanation of why the actions were taken.

A healthy laboratory must have an atmosphere in which we all feel not only that our work is important but that we are being asked to contribute the full measure of what we can contribute.

Peterfreund polled several hundred

The Jewels in the Technology Crown

GOCOS, Nunn-Warner, and the DOE

I am concerned that the understanding of the strengths of the GOCO [government-owned, contractor-operated] laboratory system is not as deep and as broadly shared as it used to be. Let me review a little of the history here.

The nuclear weapon itself evolved out of the Manhattan District Project. The initiative to get the Project going came from the scientific community: Einstein sent a letter to Roosevelt and said "Look, this is important." The scientific community lined up — to a man — to support this effort, and Los Alamos was established under the Manhattan District. The tradition of looking to the scientists to run the project, to do what is right, and of giving those scientists the freedom of action to produce the wonders that they had promised became the tradition of the Atomic Energy Commission and, later, the Department of Energy.

When Sandia was established, when the factories were established, it was AEC's policy to bring in contractors to operate these facilities and to give those contractors great freedom in operating them according to the tried-and-true, proven methods the contractors had used in their commercial enterprises. The fruits of that in my view are the jewels in the technology crown of this country.

The laboratories in the DOE that are operated on the GOCO system are far and away the best technical institutions we have, and I believe it is in large measure because of the GOCO system.

Now, several decades have gone by, administrations have come and gone, and new administrators are in place in many parts of the government. They look at this GOCO system and ask whether it is the right way to proceed: shouldn't the government take a deeper managerial role — perhaps even going so far as what some people call micro-management — to assure that the government's getting its money's worth and isn't being defrauded or whatever?

At the same time several blue ribbon panels, including the President's Science Advisory Panel (the so-called Packard Committee) and the Grace Commission, have strongly reinforced the view that the GOCO system has in fact produced the best technology institutions and that it ought to be broadened — other places ought to run more like the DOE. So we are in a sort of a crossroads, trying to sort out the best way for the government to look toward the scientific community for good research and development in its own institutions.

The Nunn-Warner bill proposal came along in a critical atmosphere in the sense that Senators Nunn and Warner are concerned whether or not the interface between the DoD and the DOE on nuclear weapon matters is optimized. One concern is whether the total weapon spectrum from conventional through nuclear is adequately traded off if the nuclear is in one agency and the nonnuclear in another. Another concern is whether the DoD takes an adequate interest in the fiscal efficiency of the nuclear weapon complex, since it is not in their budget, and whether the DOE provides sufficient back pressure to the requirements coming from the DoD.

By "back pressure" I mean DOE concern about the cost and the time that it takes to introduce certain features into nuclear weapons. The bald statement is "The DoD doesn't care about costs, and the DOE doesn't care about requirements. The DOE simply does whatever the DoD asks for, and they ask for unreasonable things they don't have to pay for."

Now that's a vast overstatement of the problem, and I think it is not an accurate perception of the process, which really works very well. But, nevertheless, there is enough half-truth here that we are about to have a blue ribbon panel looking into the matter.

The concern that I have is not so much whether some sort of fiscal reforms should be considered. What concerns me is that the management of the R&D process within the DOE is a very delicately balanced system, and it's impossible to change the way in which things are *funded* and at the same time leave the way things are *managed* intact — you can't separate the funding sources and the management control.

Therefore, if changes are to be made, it seems to me they must be made with great delicacy, in such a way as to preserve our present values in the GOCO system. If in fact the funding were totally put into the DoD, then I don't see how the DoD could avoid managing those funds, and if they managed them according to the same processes that they use to manage DoD laboratories, then it would be orthogonal to our present GOCO system.

So the whole set of concerns that surrounds Nunn-Warner, it seems to me, has more to do with the way in which we intend to manage the R&D process in the future within what is now the DOE than the rather more parochial concern about the costs of a particular weapon or trade-offs of a particular feature. I can imagine that we could get some kind of global solution to a small problem that creates a much larger problem than the one it was intended to solve.

I don't anticipate that. What will happen, I think, is that the Nunn-Warner blue ribbon panel will in fact look at the whole picture, will consider the intangibles of management as well as the tangible dollars and cents. Certainly we're optimistic about that, based on the interactions we've had so far with the group that has been put together to support the committee. The group does appear to understand what the problem is, it does appear to be seeking solutions that will preserve what we have and at the same time offer help for the future.

On the other hand, we're dealing right now with an investigation by the Inspector General as to whether we ought to build the RHIC lab and, again, it demonstrates a lack of appreciation of the GOCO system. The IG's concern is based essentially on a misperception of whether or not the DOE has had an adequate voice in approving the RHIC lab proposal.

That concern, I think, essentially goes back to whether you want to look for scientific and technical achievements to the scientific and technical experts in the laboratory, or whether you want somehow to have a job shop that is controlled in greater detail at the Washington level.

My views are very clear on this matter: *I do not believe it is possible to legislate research.* Development is a different issue — I think that detailed involvement of setting goals and priorities and requirements and expectations for product development is something very feasible and something that the DOE does very well. Even here, the *how* to do it must be left to the laboratories.

But I think that when you talk about research, about what is going to be the totally new creative thrust of the next decade, and how — this is something that you cannot force: you have to have a certain amount of faith and you have to look to the individual scientists for what those trends and those capabilities are. You can only judge the value of research after the fact: you can look back and say "Were those people right or were they wrong?" If you've got people who are usually right, what you do is back them and expect them occasionally to be wrong. — GCD

people, and the net finding was that we do not have a major problem: by-and-large, Sandians find their expectations and hopes are being realized; their relationships with their supervisors are in general good; their perception of the communications that supervisors provide is pretty good.

There is perhaps room for improvement in the top-down dissemination of information. We certainly want to work on that. But Peterfreund said that, of the laboratories he has examined — and that's quite a number, including Bell Labs — the general atmosphere, the general ethos and ambiance, here at Sandia is as good as any he has ever seen. So that was very, very good.

We certainly don't want to run a plush-lined rut here. We want this to be a Mt. Everest.

SLN: You saw no cause for concern then?

GCD: Just a little: there appeared to be at least a significant minority of people who didn't feel they were being fully stressed. Somehow we weren't asking of them the little bit of extra effort that they would like someone to ask. If that's true, that's a cause for concern — because surely a healthy laboratory must have an atmosphere in which we all feel not only that our work is important but that we are being asked to contribute the full measure of what we can contribute — the full measure, not more than we can do. It's a fine line between a stress*ful* situation and a stress*ing* situation. But we want to be sure that people feel that they are being asked to fulfill their potential right up to their limits.

I guess I'm concerned that some employees feel life is a little too easy on them. After all, we certainly don't want to run a plush-lined rut here. We want this to be a Mt. Everest.

SLN: We hear that 1985 is your last full year. Is that right?

GCD: My birth certificate says that I will be 65, which is the mandatory retirement age for Sandia policy-makers, in January of 1986. The vitality of an organization depends, I think, on the continual infusion of new points of view from the minds of more recently trained people. Therefore I think it is very important that people at all levels of the organization leave when their time comes. I have every expectation of doing just that.

SLN: Have you made plans for your retirement?

The vitality of an organization depends, I think, on the continual infusion of new points of view from the minds of more recently trained people.

GCD: I don't expect to suddenly hang up my shingle and play golf, play the piano, and molder on the vine for the rest of my life. I certainly will continue to have technical and other kinds of interests, but what those will be I don't quite know as yet.

SLN: Do you have any specific accomplishment in mind for your last year?

GCD: I hope that when I leave Sandia that I will leave it in a healthy situation in which the people, the management, the facilities — the company — are in as good a stage as they can be. I think that is a realistic goal. And I have full confidence that it will be a strong and successful organization after I leave.

State of the Budget

FY85 Looks Good, FY86 Iffy

Paul Stanford (Controller 100) discussed the FY85 Sandia budget with LAB NEWS recently. He pointed out that funding for most weapon programs has increased significantly and that reimbursables are also up, that the energy program funding has remained essentially level (though waste management is up), that the construction program is growing, and that the manpower budget has risen to 8400 from 8175 last year.

Here's the statistical picture (in terms of millions of dollars):

Program	FY84	FY85
Weapons	$472	$512
Other Defense	64	68
Energy	103	124
Reimbursables	205	222
TOTALS	$844	$926

The same comparison in terms of people (or "full-time equivalents"):

Program	FY84	FY85
Weapons	2337	2387
Other Defense	327	343
Energy	450	471
Reimbursables	812	869
Direct Support	1524	1520
Indirect Support	2727	2810
TOTALS	8177	8400

"The number of people in indirect support may make us appear to be heavy in the wrong — that is, non-mission-oriented — areas," Paul notes. "But the ratio of indirect to all others has remained constant at 33 percent since the layoffs of the early 70s. It was higher before that — about 37 percent. More important, the technical side of the house needs a strong support staff to get their jobs done right, and on time, and that's where the indirect growth has been.

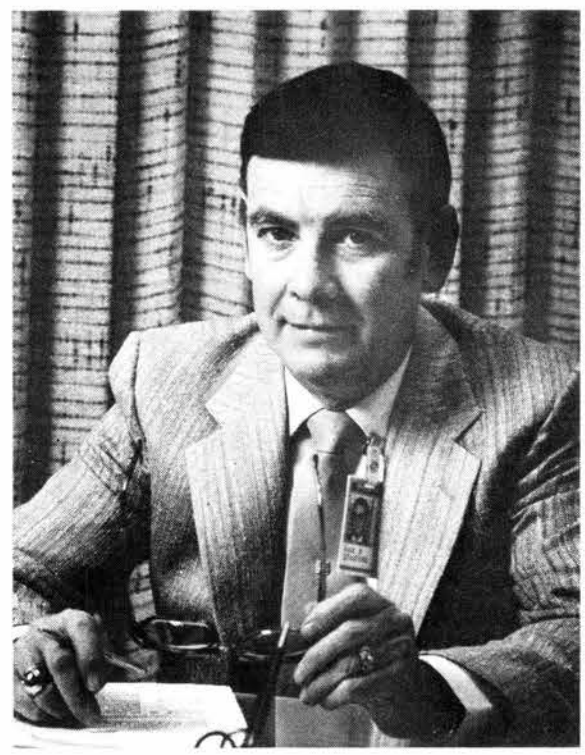
"One area that does concern us is the tremendous rise in the cost of fringe benefits, especially the health care program. Those numbers have quadrupled since FY78! Of course, since FY83 that figure now includes dental and vision care as well as retiree medical costs. But, even so, that's a 330 percent increase. It's a problem nationwide, and we lag behind the national rate."

In FY85 Sandia will continue to spend significant monies on computers (including PCs), computer-aided engineering projects, and construction. Among major ongoing construction projects are PBFA-II (particle beam fusion, second generation) and a simulation technology lab. Major new starts include a weapons lab building at Livermore, a process development lab and a $40 million RHIC (radiation-hardened integrated circuit) lab in Albuquerque. Not as obvious but equally important is the equipment and utilities restoration program that took a large jump in FY84 and will increase again slightly in FY85. That program is allowing Sandia to upgrade utilities and equipment in several old buildings to reasonable standards.

"Sandia has recently concluded a study of how to increase some needed indirect areas — Plant Engineering and Security — without changing the overall Lab indirect ratio," Paul says. "This once again demonstrates Labs management resolve to prioritize those activities necessary with minimum cost impact to our direct programs. This can also be accomplished by reduction in other indirect areas of the Labs through retirement and termination.

"Overall, the operating budget is up 10 percent, and the new construction and capital program is getting started. Sandia looks very good for FY85.

"Our FY86 funding plan is very iffy now. Defense is up while many other programs are down. Due to the debate surrounding the large federal deficit, I feel Sandia's total funding will be no greater than FY85, so this means we'll tighten our belts in order to accomplish those higher priority programs of national interest."



CONTROLLER PAUL STANFORD

Format of This Special LAB NEWS

This LAB NEWS is actually three issues in one — peel off the outside eight pages and President Dacey's "State of the Labs" message is complete. The next eight outside pages are the complete Technical Accomplishments 1984 special section. The remaining pages are your standard LAB NEWS. It was designed this way to enable additional copies of the special sections to be printed separately.